DRAFT COPC TECHNICAL MEMORANDUM
SAN JACINTO RIVER WASTE PITS SUPERFUND SITE

Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin
2,3,7,8-TCDF	2,3,7,8-tetrachlorodibenzofuran
95UCL	95 percent upper confidence limit on the mean
BEHP	bis(2-ethylhexyl)phthalate
COC	chemical of concern
COI	chemical of interest
COPC	chemical of potential concern
DQO	Data Quality Objective
ER-M	Effects Range-Median
IPC	International Paper Company
K-S	Kolmogorov-Smirnov
LOAEL	lowest-observed-adverse-effect level
MIMC	McGinnes Industrial Maintenance Corporation
MWW	Mann Whitney Wilcoxon
PCB	polychlorinated biphenyl
PAH	polycyclic aromatic hydrocarbon
PRG	Preliminary Remediation Goal
PSCR	Preliminary Site Characterization Report
QA	quality assurance
REV	reference envelope value
RI/FS	Remedial Investigation and Feasibility Study
RME	reasonable maximum exposure
SAP	Sampling and Analysis Plan
Site	San Jacinto River Waste Pits site in Harris County, Texas
SJRWP	San Jacinto River Waste Pits
SWAC	spatially-weighted average concentration
TEF	toxic equivalency factor
TCEQ	Texas Commission on Environmental Quality
TEQ	toxicity equivalent

TEQ_{DF}	toxicity equivalent for dioxins and furans
TEQ_{DFP}	cumulative toxicity equivalent for PCBs and dioxins and furans
TEQ_{PCB}	toxicity equivalent for polychlorinated biphenyls
TMDL	total maximum daily load
TxDOT	Texas Department of Transportation
UAO	Unilateral Administrative Order
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

—place holder for southern impoundments

1 INTRODUCTION

This technical memorandum was prepared on behalf of International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC; collectively referred to as the Respondents) in fulfillment of the 2009 Unilateral Administrative Order (2009 UAO), Docket No. 06-03-10, issued by the U.S. Environmental Protection Agency (USEPA) to IPC and MIMC on November 20, 2009 (USEPA 2009c), for the San Jacinto River Waste Pits (SJRWP) site in Harris County, Texas (the Site). The 2009 UAO directs the Respondents to perform a Remedial Investigation and Feasibility Study (RI/FS) for the Site.

The 2009 UAO requires that a "Potential Chemicals of Concern Memorandum" be part of the RI/FS, and that this memorandum be submitted after USEPA approval of the Preliminary Site Characterization Report (PSCR). For this Site, the source of hazardous substances is paper mill waste contained in the impoundments. The specific hazardous substances present were identified in the Screening Site Assessment Report (TCEQ and USEPA 2006) and by an evaluation of chemical constituents likely to occur in paper mill wastes generated in the 1960s (Integral and Anchor QEA 2010). From this information, chemicals of potential concern (COPCs) were identified in the Sediment Sampling and Analysis Plan (SAP) (as documented in the RI/FS Work Plan, Appendix C) (Anchor QEA and Integral 2010a~~), and~~ dioxins and ~~furans~~ were selected as the ~~indicator chemical~~ group for this Site. The "Potential Chemicals of Concern Memorandum" was therefore not included in the project schedule in Chapter 8 of the approved RI/FS Work Plan. Nevertheless, identifying COPCs for the Site and documenting them in this technical memorandum will allow Respondents and USEPA to focus the RI/FS and meet the project schedule required by USEPA and the 2009 UAO. ~~Therefore~~, this document fulfills the requirement of the 2009 UAO for a "Potential Chemicals of Concern Memorandum," and supplements the RI/FS Work Plan and the SAPs submitted in support of the RI/FS.

1.1 Purpose

This memorandum documents the process and rationale used to select COPCs for the Site, identifies the final COPCs for the Site, and addresses certain requirements for laboratory analysis of primary and secondary COPCs in environmental samples collected as part of the RI/FS. COPCs are those chemicals that will be evaluated by the Baseline Human Health Risk

Assessment and the Baseline Ecological Risk Assessment, and from which chemicals of concern (COCs) will be identified. COCs are those chemicals for which Preliminary Remediation Goals (PRGs) will be developed.

Appendix C of the RI/FS Work Plan provides an overview of the process used to identify chemicals of interest (COI) and to identify COPCs from the COI list. This evaluation occurred prior to RI sediment sampling and resulted in the definition of "primary" and "secondary" COPCs for this Site (Table 1). Primary COPCs were defined specifically for either human or ecological receptors, or for both, and are those chemicals that will be addressed by the baseline risk assessments. Secondary COPCs are those for which one or more key uncertainties were present prior to sediment sampling, and for which decisions regarding the need for analysis in archived samples and for risk assessment are to be made on the basis of results of the sediment sampling program.[1]

Results of analyses presented in this document determine the requirements for analyses of secondary COPCs in groundwater samples and in archived samples of sediment, tissue, and soil from the Site. In addition, the data quality objectives (DQOs) for Study Element 2 in the Sediment SAP (Section 1.10.2.2) describe archiving some of the nearshore sediment samples and state that any analysis of these samples will be contingent upon analytical results at adjacent locations. This document also presents that evaluation, and addresses whether primary or secondary COPCs will be analyzed in these archived nearshore sediment samples.

Finally, a supporting analysis is addressed by this memorandum. The DQOs for Study Element 1 (the nature and extent evaluation) of the Sediment SAP (Section 1.10.1.2) include an analysis of temporal changes in dioxins and furans in sediment between 2005 and 2010. This evaluation was required by USEPA to address uncertainties concerning the effect of Hurricane Ike in September, 2008 on sediments surrounding the impoundments north of I-

Was this analysis borne out after validated data

[1] Several volatile organic compounds (VOCs) were considered COPCs prior to sediment sampling, but were not brought forward as COPCs. An evaluation of unvalidated data performed during sediment sampling found that VOCs were undetected outside the impoundments and in all subsurface samples within the impoundments. Within the impoundments, some surface samples contained a few VOCs at concentrations that were just above detection limits and were J-qualified (estimated). These findings were shared with USEPA, who agreed that further analyses for VOCs in sediments were not necessary (USEPA 2010).

10. Results of this analysis are needed to begin the process of defining the baseline data set that will be used for risk assessments and in other aspects of performing the RI.

1.2 Document Organization

The analysis steps and results presented in this technical memorandum follow DQOs and related statements and information presented by the Sediment SAP (Integral and Anchor QEA 2010) and the RI/FS Work Plan (Anchor QEA and Integral 2010a). This document also addresses COPCs for soil, groundwater, and tissue consistent with discussions provided by the Soil SAP (Integral 2010a), the Groundwater SAP (Anchor QEA and Integral 2010b), and the Tissue SAP (Integral 2010b). Therefore, this memorandum presents a synthesis of analytical steps and related decisions that were outlined in these earlier documents. The document is organized as follows:

- Data selection and data treatment
- Comparison of dioxins and furans in sediment in 2005 with dioxins and furans in sediment in 2010
- Selection of final COPCs (and related discussion regarding analysis of archived samples and groundwater)
- Analysis of nearshore sediment chemistry data (and related discussion regarding analysis of archived sediment)
- Summary.

2 DATA SELECTION AND DATA TREATMENT

Consistent with the decisions outlined in the sediment, soil, groundwater, and tissue SAPs (Integral and Anchor QEA, 2010; Integral 2010a; Anchor QEA and Integral 2010b; Integral 2010b), analysis of sediment data informs selection of COPCs for the human health and ecological risk assessments. This section outlines the available sediment data, the data sets used in these evaluations, and the related data treatment rules.

2.1 Summary of Available Data Sets

The studies or programs providing sediment chemistry data for use in the RI/FS are outlined in Table 2 Although useful for descriptive purposes, most of these data are excluded from COPC decision making based on data evaluations described in this memorandum, the age of the data, or DQOs established by earlier documents. Among the available sediment data, only the surface sediment chemistry data generated by the 2010 Site and upstream sampling were used for the majority of quantitative evaluations described in this memorandum, consistent with DQOs (Integral and Anchor QEA 2010). Surface sediment samples included both sediment grab samples obtained from 0 to 6 inches (0 to 15 cm), and the uppermost increments from core samples (0 to 2 feet; 0 to 61 cm).

In addition to the 2010 sediment data, the sediment data collected in the sampling grid surrounding the northern impoundments by Texas Commission on Environmental Quality (TCEQ) in 2005 (University of Houston and Parsons 2006) were used in the comparison of 2010 with 2005 conditions. Prior to conducting the analysis, the TCEQ dataset was validated and upgraded to Category 1 data (see Section 3 of the RI/FS Work Plan). Documentation of the data validation and quality assurance (QA) investigation is provided in Appendix A. In addition, the data for polychlorinated biphenyl (PCB) congeners in sediments, both on the Site and upstream, collected at TCEQ monitoring stations (University of Houston and Parsons 2009) were also used in the analysis presented below. Validation of these data by Integral is in progress and will be documented in the PSCR. Figure 1 shows the locations of the surface sediment samples used in the analyses presented in this memorandum.

2.2 Data Treatment Rules

Data treatment rules were executed as described in the Project Data Management Plan (Appendix A of the RI/FS Work Plan). For chemicals that were not detected, concentrations were estimated as one-half the estimated detection limit for dioxin and furan congeners and as one-half the method reporting limits for all other chemicals.

Results for field duplicate and laboratory replicate pairs were averaged using data rules outlined in Section 6.5 of the Data Management Plan prior to performing the analyses.

Where toxicity equivalent (TEQ) concentrations are presented for either PCBs (TEQ_{PCB}) or for dioxins and furans (TEQ_{DF}), mammalian toxic equivalency factors (TEFs) from van den Berg et al. (2006) were used, and non-detects were assumed to be equal to one-half the detection limits for each congener prior to multiplication by the TEF. In no case is a cumulative TEQ for PCBs and dioxins and furans (TEQ_{DFP}) used in this report.

3 COMPARISON OF DIOXINS AND FURANS IN SEDIMENT: 2005 VS. 2010

CERCLA guidance (USEPA 1988) states that a baseline risk assessment is performed to identify the existing or potential risks at a site, support a determination of whether remediation is needed, and serve as the basis for the evaluation of the effectiveness of any subsequent remedial action. Determination of an appropriate baseline data set, which will be used to describe the current site conditions, is therefore a key step of the RI/FS process. The analysis in this section provides the basis for development of the baseline data set.

DQOs in Section 1.10.1.2 of the Sediment SAP require analysis of temporal changes in dioxin and furan concentrations in sediment surrounding the impoundments north of I-10, by comparison of the concentrations in sediment in 2005 with those in 2010. This section describes how surface sediment data collected in 2010 were compared with sediment data collected by TCEQ in 2005 (University of Houston and Parsons 2006), and provides a determination of whether the two datasets may be combined to represent baseline. Consistent with the DQOs provided in the Sediment SAP, if significant changes to surface sediment chemistry have occurred during the time interval between the two sampling events, the 2005 data will not be considered part of the baseline data set.

3.1 Methods

Comparisons between 2005 and 2010 were performed for each dioxin and furan congener, and for the total (sum) of dioxin and furan congener concentrations using the following analytical steps:

1. Spatial pairing of 2005 and 2010 locations
2. Spatial weighting and conversion of data to a common metric
3. Spatially-resolved comparisons between the 2005 and 2010 datasets using paired two-sample tests

Details of these methods are provided in the following subsections.

3.1.1 Spatial Pairing

The Sediment SAP (Integral and Anchor QEA 2010) Section 1.10.1 presents a specific analysis path for the characterization of temporal changes in dioxin and furan concentrations in sediment using a grid-based spatial pairing of 2005 and 2010 samples, in which two-sample tests are used to compare each sample with its nearest neighbor. However, because of large differences in the spatial scales, spatial resolution, and the numbers of samples in the two investigations, this approach did not provide a practical means of pairing locations between the two studies. A comparison to nearest neighbor samples would have left many points sampled in 2010 with no corresponding point in 2005 and thereby resulted in lost information; or would have required the use of individual points from 2005 for comparison with multiple points from 2010, which would have inappropriately and arbitrarily weighted individual 2005 data points. A means to resolve the spatial discrepancies between the two data sets was needed.

The spatial pairing of 2005 and 2010 stations was accomplished by using Thiessen polygons to associate a physical area of the Site with each sampling station from each event. A Thiessen polygon is defined as the area around a sampling location that includes all points in space that are closer to that sampling location than they are to any other sampling location. Area-weighting using Thiessen polygons is a well-established method of accounting for different spatial sampling densities within and across sampling programs. Area-weighted averaging is a recommended method for addressing spatially variable data (NRC 2007; Reible et al. 2003; USEPA 2001, 2007c, 2009b; DTSC 1992), and it has been applied at other Superfund sites (USEPA 1998; WIDNR 2001; LDWG 2003).

In the first step of this analysis, separate sets of Thiessen polygons were created for each of the 2005 and 2010 sampling data (Figure 2), including the area of the Site and upstream. These two sets of polygons were then combined (intersected) to produce a third set in which each polygon corresponds to exactly one 2010 and one 2005 location where measurements of sediment chemistry were collected (Figure 3).

3.1.2 Area Weighting and Data Conversion

For the second step of this analysis, the area of each polygon resulting from the intersection of the 2005 and 2010 polygons is used to weight each of the 2005 or 2010 concentration represented by that polygon. Because the result would then be expressed as "ng-m^2/kg", an additional conversion is made so that the final parameter used in the comparison is mass (kg).

This approach establishes a common footing for both the 2005 and 2010 data sets, accounts for size difference among the polygons for the two data sets, prevents potential artifacts of multiple comparisons in statistical evaluations, and provides the basis for the calculation of site-wide spatially-weighted average concentrations (SWACs). It is not intended to provide an actual estimate of chemical mass for any purpose.

The calculation to compute the area-weighted concentrations for each polygon, and to convert each concentration-area term (ng-m^3/kg) to a simpler but equivalent expression of mass (kg), was as follows:

$$Mass_{D/F}[kg] = Concentration_{D/F}\left[{ng}/{kg}\right] \times 10^{-12}\left[{kg}/{ng}\right] \times Area[m^2] \times Depth[m] \times Density\left[{kg}/{m^3}\right] \times f_{solids}$$

The conversion of area-weighted concentrations to units of mass involves only multiplication by constant values (two constants representing sediment percent solids [0.8] and bulk density [2,000 kg/m^3]; Arnarson and Keil 2001) were used. Therefore, this calculation does not affect the relationship between the measurements in different samples or data sets and does not affect the results of statistical analyses. The conversion of area-weighted concentration to mass was carried out only to provide conceptually meaningful units on the axes of figures, illustrating the cumulative distribution function of each data set (Appendix B). Omitting this conversion would not alter the results of the statistical tests or the conclusions.

3.1.3 Statistical Comparisons of Dioxin and Furan Concentrations

Finally, the results of the area-weighted 2005 and 2010 dioxin concentrations, following the conversions described above, for the entire set of polygons were compared to determine whether they were statistically different, as prescribed in the Sediment SAP (Integral and Anchor QEA 2010). Two nonparametric statistical tests were used: the paired Mann Whitney Wilcoxon (MWW) test, and the two-sample Kolmogorov-Smirnov (K-S) test. Nonparametric tests were used because neither data set was normally distributed (as evaluated using a Shapiro-Wilk test with a critical value of $p < 0.05$). The paired MWW test evaluates the differences between 2005 and 2010 data sets for each polygon, and whether the central tendency of these differences is statistically different from zero (Corder and Foreman 2009); that is, whether or not the two distributions have the same mean value. The two-sample K-S test evaluates whether the two distributions (2005 and 2010) are similar regardless of pairing and can potentially identify differences between distributions even when their means are the same (Corder and Foreman 2009). Using both tests together provides information about the relationship between the two datasets and about potential temporal trends.

Consistent with the Sediment SAP (Integral and Anchor QEA 2010), both statistical tests were carried out as two-tailed tests, so that the tests would identify either increases or decreases in dioxin concentrations between the two sampling events. The level of statistical significance used for these tests was 0.05 ($\alpha = 0.05$).

3.2 Results and Discussion

The spatial correspondence framework described above created a set of 314 polygons (Figure 3) each corresponding to a unique pair of 2005 and 2010 sediment sampling stations. The total area contained by all polygons was slightly over 104 million square feet (or approximately 2,400 acres, or 970 ha) and represented the common surface characterized by the 2005 and 2010 sampling events in and around USEPA's preliminary site perimeter, and upstream to the mouth of the San Jacinto River.

Overall, there was a decrease in dioxin and furan concentrations consistent across all congeners, as evidenced by the comparison of SWAC values for each congener for the 2005 and 2010 surface sediment data (Table 3). Concentrations of the various congeners decreased by a factor of 2 to 10 between 2005 and 2010. The results from the paired (MWW test) and overall (K-S test) statistical comparisons indicate that the observed decrease in dioxin and furan concentrations in surface sediments are statistically significant ($p \leq 0.05$) for all congeners individually, and for the sum of all dioxin and furan congeners (Table 3). The data used for these statistical comparisons are shown in Appendix B, which display the cumulative distributions of each dioxin and furan congener (as kg), and for the total dioxins and furans, in all of the Thiessen polygons from the intersected dataset. All congeners and their total show lower values for 2010 than for 2005 across the entire range of concentrations. These results indicate that the 2005 data should not be included in the baseline dataset because it does not accurately represent current conditions.

This overall trend was evaluated geospatially within each polygon. Changes in dioxins and furans within individual polygons were generally greater than laboratory variability for environmental samples (35 percent relative percent difference), indicating that the difference observed in this analysis is not the result of the use of different laboratories. The dioxin and furan composition of 29 of the 314 polygons (approximately nine percent) was below the 35 percent relative percent difference threshold; these could be considered relatively unchanged between 2005 and 2010. In the remaining area with significant changes, the dioxins and furans were greater in 2010 than in 2005 within 27 polygons (or about 550 acres), and lower in 258 polygons (1,700 acres). This result supports the conclusion that substantial changes occurred in surface sediment chemistry across the majority of areas on and around the site in the recent past, resulting in an overall reduction in each dioxin and furan congener concentration.

3.3 Conclusions

Taken together, these results demonstrate a widespread and significant difference between 2005 and 2010 in the concentrations of dioxins and furans in surface sediments. Following the decision rules established in the Sediment SAP (Integral and Anchor QEA 2010), baseline conditions for all COPCs will not include sediment chemistry data generated for the Site in 2005 (University of Houston and Parsons 2006). Using the same rationale, i.e., that significant changes have occurred in sediments between 2005 and 2010, any sediment data sets from 2005 and earlier (Table 2) will also not be included in the baseline sediment data set. A complete analysis of the data that will be used to describe the baseline condition for the RI will be presented in the PSCR for the RI, to be provided to USEPA in July 2011.

4 SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Appendix C of the Draft RI/FS Work Plan (Anchor QEA and Integral 2010a) describes the methods and rationale for selection of COIs that are used as the basis for identification of COPCs for the RI/FS; this process is summarized in Figure 4. According to this method, COIs were those chemicals that are among USEPA's priority pollutants, were reported by one or more technical papers as potentially occurring in pulp mill solid wastes or leachate from solid waste landfills containing pulp mill wastes, and are likely to have bound to sediment organic carbon or could otherwise have persisted for more than 40 years in the Site environment. These COIs provided the starting list from which primary and secondary COPCs were identified (Integral and Anchor QEA 2010).

All chemicals identified as primary COPCs in the Sediment SAP (Table 1) have been analyzed in all samples collected on the Site to date, and will be addressed by the baseline risk assessments. Therefore, there are no decisions about primary COPCs pending, and primary COPCs are not discussed further in this section. Secondary COPCs are those chemicals for which one or more key uncertainties was present prior to 2010 sediment sampling, and for which decisions regarding the need for risk assessment, and regarding analysis in groundwater and in archived samples of soil, tissue, and sediment are to be made on the basis of the results of the sediment sampling program. This section addresses the steps taken to evaluate whether these secondary COPCs should be retained as COPCs for the risk assessments and in which media they should be analyzed.

4.1 Evaluation of Secondary COPCs

According to decision rules established in the Sediment SAP (Integral and Anchor QEA 2010), secondary COPCs will be considered in the baseline risk assessment if they meet both of the following conditions:

- The chemical is detected in greater than 5 percent of surface sediment samples collected for the RI/FS
- The chemical fails the risk-based screens for human and/or ecological receptors.

There is one additional consideration that is made, potentially excluding a chemical from the risk assessments:

- If the concentration of the chemical in surface sediments correlates with those of one or more dioxin and furan congeners that is characteristic of the waste materials in the impoundments, it will not be included in the risk assessments because risk management efforts for dioxins and furans will address risks associated with those chemicals that correlate with dioxins and furans in sediments.

As noted in each SAP, additional information may be considered in the final definition of COPCs for the risk assessments. For example, PCB congeners are included in the analyte list for all tissue samples, even though they have been considered secondary COPCs to date. This was required by USEPA because PCBs are both bioaccumulative and their toxicity may be additive with toxicity of dioxins and furans in some species.

In the following sections, each of the analysis steps to identify the final COPC list is applied to data for secondary COPCs in surface sediments collected in 2010. The analysis steps are as follows:

- Evaluation of detection frequency in surface sediments for each chemical
- Evaluation of concentrations in sediment using risk-based screens
- Analysis of statistical correlation between each secondary COPC and dioxin and furan congeners that are characteristic of the material in the impoundments
- Consideration of additional information.

These analyses are performed in the order shown above, and if a secondary COPC is eliminated using one analysis step, it is not considered in the subsequent analysis step.

4.1.1 Frequencies of Detection of Secondary COPCs

The first consideration in the evaluation of secondary COPCs is detection frequency. Detection frequency is considered because all of the secondary COPCs were chemicals that had never been measured, or that had never been detected in sediments from the Site at the start of the RI. That is, it was considered possible that the chemical was present on the basis of the literature on paper mill wastes, but there was no evidence that the chemical was actually present. Therefore, if a chemical was detected in 5 percent or fewer surface sediment samples collected in 2010, it will not be considered further by the RI.

The following secondary COPCs were never detected in surface sediments collected in 2010 (Table 4), and are, therefore, removed from further consideration in the RI:

- 2,3,4,6-Tetrachlorophenol
- 2,4,5-Trichlorophenol
- 2,4,6-Trichlorophenol
- 2,4-Dichlorophenol
- Hexachlorobenzene
- Pentachlorophenol.

The remaining secondary COPCs had detection frequencies >5 percent: PCBs (a secondary COPC for humans, fish, and wildlife only), thallium, and several semivolatile organic compounds (all secondary COPCs for the benthic community only) (Table 4). These secondary COPCs are carried forward through the additional analysis steps below.

4.1.2 Risk-Based Screening

Screening values for human and ecological receptors for use in the risk-based screens were established in the RI/FS Work Plan and the Sediment SAP (Anchor QEA and Integral 2010a; Integral and Anchor QEA 2010). The discussion of screening below uses the same screening benchmarks.

Among the secondary COPCs that remain for additional evaluation, only PCBs are considered to be a possible COPC for human health and for fish and wildlife; all others are considered to be possible COPCs for only the benthic invertebrate community. In sediments, only the "dioxin-like" PCB congeners were quantitated by the analytical laboratory. The maximum total PCB concentration (as the sum of dioxin-like congeners) in sediment exceeds the human health screening benchmark at one location (SJGB014). When congeners are considered individually, PCB 118 and PCB 126 exceeded their respective human health screening values (Table 5). PCB 118 exceeded its screening value of 110 µg/kg once, at station SJGB014. PCB 126 exceeds its screening level value of 0.034 µg/kg at three stations, SJGB010, SJGB012, and SJGB014 (at station SJGB014, a non-detect exceeds the screening level). The locations of these exceedances are within the original impoundment perimeter. A sediment screening level for fish and wildlife was not established for PCBs, but

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because PCBs are potentially bioaccumulative, PCBs were retained by the screening as a potential COPC for people, fish, and wildlife. PCBs are not considered a COPC for benthos, so were not subjected to a benthic risk screen. Below, correlation between individual PCB congeners and dioxins and furans in sediments is evaluated, consistent with the methods described in the Sediment SAP.

The remaining secondary COPCs, all for benthic invertebrate communities (Table 4), were evaluated using screening benchmarks for benthic organisms. Benthic screening benchmarks are not available for thallium, carbazole, or phenol, so risk-based screening does not provide information regarding these chemicals. For each of the four polycyclic aromatic hydrocarbon (PAH) compounds (acenaphthene, fluorene, naphthalene, and phenanthrene), the maximum concentration in 2010 surface sediments exceeds its respective screening level for benthos in at least one location (Table 6), and, therefore, were not excluded as potential COPCs using risk-based screens.

4.1.3 Analysis of Statistical Correlations of Secondary COPCs with Dioxins and Furans

Appendix C of the RI/FS Work Plan establishes the use of dioxins and furans as an indicator chemical group for the Site, a concept provided for in USEPA guidance on performance of RI/FSs at CERCLA sites (USEPA 1988). This designation was made because dioxins and furans are persistent, are likely the most toxic chemicals at the Site, and are likely to contribute most significantly to overall risk at the Site. Use of dioxins and furans as an indicator chemical helps to focus the required analyses, reducing the time required to develop and evaluate remedial alternatives. According to the Sediment SAP, secondary COPCs that statistically correlate with dioxin and furan congeners representative of the waste in the impoundments will not be evaluated further as COPCs in soils or sediments (with the caveat noted in Section 4.1). This decision rule is based on the assumption that any risk associated with a secondary COPC that correlates with representative dioxins and furans is likely to be addressed by ~~sediment~~ remediation performed to address risk due to dioxins and furans.

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2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF) were frequently detected in ~~sediments~~ samples collected from within the impoundments. To determine whether these could be considered representative of ~~sediments~~ waste sludge from within the impoundments for the correlation analyses, the proportion of the total dioxin and furan concentration was calculated for each congener using the 2010 surface sediment samples collected from within the original impoundment perimeter, and for 2010 sediment samples collected from outside of the impoundment perimeter (Table 7). Results support the use of 2,3,7,8-TCDD and 2,3,7,8-TCDF as representative of the impoundment materials for the purposes of this evaluation because these two congeners show the greatest differences as a percent of total dioxins and furans from within the impoundment perimeter, where the contribution of these congeners is high, and those from outside, where their contribution as a percent of the total is low.

Statistical analyses to determine whether each of the remaining secondary COPCs correlate significantly with 2,3,7,8-TCDD and with 2,3,7,8-TCDF were performed. The correlation statistic used was Kendall's tau-b because of the relatively high number of non-detects for some chemicals (Table 4); this statistic is robust for highly censored data sets (Helsel 2005). The results of these analyses are as follows:

- **Thallium.** Thallium was weakly but significantly correlated with both 2,3,7,8-TCDD and 2,3,7,8-TCDF (Table 8).
- **Dioxin-like PCBs.** Relatively strong and significant correlations were found between the majority of PCB congeners (eight of eleven congeners) and both 2,3,7,8-TCDD and 2,3,7,8-TCDF (Table 8). Correlations of 2,3,7,8-TCDD and 2,3,7,8-TCDF with PCBs 81, 126, and 169 were weak and non-significant.
- **PAH compounds.** All four PAH compounds considered secondary COPCs had positive but weak correlation with 2,3,7,8-TCDD and 2,3,7,8-TCDF (Tau ≥ 0.3) that were all statistically significant ($p < 0.05$) (Table 8).
- **Phenol.** Phenol showed a weak but significant correlation with 2,3,7,8-TCDF, and no significant relationship with 2,3,7,8-TCDD.
- **Carbazole.** Correlation between carbazole and 2,3,7,8-TCDD and 2,3,7,8-TCDF were weak and not significant (Table 8).

According to decision rules established by the Sediment SAP, these results suggest that thallium, PCBs, and PAH compounds are candidates for removal from consideration in the risk assessments. Additional considerations for each of these COPCs are discussed in the next section.

4.1.4 Additional Considerations in Identification of COPCs

All of the SAPs indicate that additional information may be considered for each chemical in the final determination of COPCs for the RI. USEPA has already used this approach to require the analysis of PCBs in tissue collected for the RI, and for their analysis in the risk assessment (for humans, fish, and wildlife), as noted in Section 4.1. This section reviews additional information to be considered in the final determination for each chemical. These are observations not available or anticipated when the SAPs were written, including the spatial distribution of each chemical in surface sediments, the magnitude of concentrations in sediments already analyzed, and the relevance and availability of toxicological information for these chemicals.

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- Thallium. Although thallium is a secondary COPC, it was reported by the laboratory for all 126 surface sediment samples. In this data set, thallium was detected in fewer than 10 percent of surface sediment samples (Table 4). Sediments in which thallium was detected were primarily from within the impoundments, with two additional detections; one northwest of the impoundments and the other along the shoreline west of the upland sand separation area (Figure 5). Moreover, because thallium was reported for all 126 surface sediment samples (Table 4), it has been completely characterized for surface sediments on the Site and no archived surface sediment samples are in question. In addition, there were no detections of thallium in soils evaluated from the Texas Department of Transportation (TxDOT) right-of-way (Integral 2010a), and thallium was detected in one out of three surface soil samples and two out of three subsurface soil samples collected from the upland sand separation area, but were present at levels that were an order of magnitude below screening levels for industrial soil (Integral 2010a). Thallium is not considered to be bioaccumulative (TCEQ 2006), so it is not a COPC for humans, fish, and wildlife. There are no benthic screening values for thallium.
- PCBs. Three of the dioxin-like PCB congeners did not correlate with 2,3,7,8-TCDD

and 2,3,7,8-TCDF: PCBs 81, 126, and 169, but all other congeners do correlate significantly with both 2,3,7,8-TCDF and 2,3,7,8-TCDD (Table 8). These three congeners were detected with relatively low frequency (4 to 19 percent), while detection frequency for the other congeners ranged from 45 to 85 percent (Table 4). Total PCBs, as a sum of dioxin-like congeners, exceeded the human health screening level at one station within the impoundment perimeter; where there were exceedances of screening levels by individual congeners (Section 4.1.2), they also occurred only within the impoundment perimeter. Outside the impoundment Southern impoundment perimeter, neither congeners nor the limited estimate of total PCBs exceeded risk-based screening levels (Figure 6). In addition, PCBs in surface sediment (as the TEQ_{PCB}), were compared to the reference envelope value (REV) for this parameter. The REV for TEQ_{PCB} was calculated using only samples upstream of USEPA's preliminary site perimeter, including those collected in 2010 and those produced by TCEQ's total maximum daily load (TMDL) program (Koenig 2010, pers. comm.; University of Houston and Parsons 2009) (Stations 11200 and 16622), for a total of 17 samples. These data were clearly lognormally distributed (i.e., the distribution is known), and therefore the parametric REV is considered representative of the upstream background condition. This REV for TEQ_{PCB} is 9.87 ng/kg dw. All but one of the TEQ_{PCB} concentrations in surface sediment on the Site are below this value. The TEQ_{PCB} concentration at SJGB014 is 27.5 ng/kg dw, which exceeds the REV.

- **PAH compounds.** The four PAH compounds considered secondary COPCs were both detected and exceed no-effect screening levels protective of benthic invertebrate communities in several locations, most commonly within the impoundment perimeter; both detections and exceedances for these chemicals seem to decline with distance from the impoundments (Figure 7). Figure 7 shows that at only two stations Southern Impoundment outside the original impoundment perimeter was one or more PAH compound both detected and in exceedance of the benthic screening value (SJNE008, SJNE035). Screening values used in this analysis are concentrations at which no adverse effect on benthic invertebrate communities can be expected. To provide additional perspective on the concentrations of PAHs in the existing surface sediment data set, screening levels defining lowest-observed-adverse-effect levels (LOAELs), were also considered. These values are the Effects Range-Median (ER-M) concentrations, taken from the same source (Long et al. 1995) as the source used for TCEQ's no-effects levels (TCEQ 2006). These are concentrations above which adverse effects on benthic communities may occur. Among all 2010 surface sediment samples, exceedances of the LOAEL screening value (Table 6) occur in a single sample collected from within the impoundment (Figure 8). Two of the PAHs, naphthalene and phenanthrene, do not exceed any LOAEL-based sediment benchmark derived from the same source as the no-observed-effect concentration (Long et al. 2005).

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Phenol and Carbazole. The only locations at which phenol was detected in surface sediment samples were within the waste impoundments (Figure 9). Similarly, the highest concentrations of carbazole are detected in the impoundments (Figure 10). In addition, there are no benthic screening levels for these two chemicals for use in interpretation of sediment chemistry data. In upland soils collected to date (for the TCRA), concentrations of phenol and carbazole in soils were below the industrial soils screening levels (Integral 2010a).

In the final analysis presented in the next section for any given chemical, the utility of additional information in selection of a remedy is also considered.

4.2 Summary of COPC Selection

The analyses discussed in this section on rates of detection, results of risk-based screening, statistical correlations with 2,3,7,8-TCDD and 2,3,7,8-TCDF, and additional considerations on the magnitude and spatial distribution of detected concentrations were synthesized to derive final recommendations for COPCs to be considered by the baseline risk assessments. This synthesis also addresses whether groundwater and archived samples of soil, sediment, and tissue should be analyzed for any of the COPCs. A summary of the conclusions is provided in Table 9, and a detailed summary of the rationale for each chemical or chemical group is provided below. Those chemicals that were immediately eliminated from further consideration on the basis of low detection frequency are not discussed in this section.

Thallium

Thallium should be retained as a COPC for assessment of risk to the benthic community because:

- Detection frequency in surface sediments was greater than 5 percent
- Thallium does not correlate with 2,3,7,8-TCDD or 2,3,7,8-TCDF.

Thallium should not be analyzed in archived sediment samples because:

?

is that true?

- Thallium has been characterized in all surface sediments samples and has a very low detection frequency. It is highly unlikely to be a risk driver for this site, so additional information on thallium in subsurface sediments is unlikely to be useful in selection of a remedy.

Thallium should not be analyzed in archived tissue samples because:

- Thallium is not considered to be bioaccumulative (TCEQ 2006) and was therefore not retained as a COPC for human health or fish and wildlife.

Thallium should not be analyzed in archived soil samples because:

- Thallium is considered to be a COPC only for benthic invertebrates.

Thallium should be analyzed in groundwater samples because:

- Detection frequency in sediments was greater than 5 percent
- The highest concentrations and the majority of detected concentrations occurred within the impoundments.

Thallium will be retained as a COPC for the benthic risk assessment, but the evaluation of risk will be conducted using available data for sediments because additional information on thallium in sediments is unlikely to be useful in selection of a remedy.

PCBs

PCBs should be retained as a COPC for assessment of risk to human receptors, fish, and wildlife because:

- Detection frequency in surface sediments was greater than 5 percent
- PCBs are considered to be bioaccumulative

2005 data; what is it being used for? (beef up the #s eg #of samples)

- The toxicity of some PCB congeners is considered to be additive with that of dioxins and furans.

PCBs should not be analyzed in archived sediment samples because:

- Most PCB congeners evaluated in sediment correlate strongly and significantly with 2,3,7,8-TCDD and 2,3,7,8-TCDF
- Exceedance of human health risk-based screening levels for dioxin-like congeners in surface sediment occurred only within the impoundment perimeter, and only for two congeners
- The available data for the site indicates that, with the exception of one sample collected from a station within the impoundments, the TEQ_{PCB} is below the REV (based on upstream samples only) for this parameter
- In light of the information noted above, additional information on PCBs in sediments is unlikely to be useful in selection of a remedy at this site.

Southern impoundment!

might be useful in selection of remedy for waste pit

PCBs have been analyzed in all tissue samples because:

- PCBs are considered to be bioaccumulative
- Tissue data are needed for the risk assessment
- USEPA requires that PCBs be analyzed in tissue.

PCBs should not be analyzed in archived soil samples because:

- Most PCB congeners evaluated in sediment correlate strongly and significantly with 2,3,7,8-TCDD and 2,3,7,8-TCDF
- Available soil data indicate that, although PCBs have been detected in soil, concentrations do not exceed conservative soil screening values.

PCBs should be analyzed in groundwater samples because:

- Detection frequency of most congeners in sediments was greater than 5 percent.

PAH Compounds: Acenaphthene, Fluorene, Naphthalene, and Phenanthrene

The four PAH compounds addressed should not be retained as COPCs for assessment of risk to the benthic community because:

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- Three of the four PAHs were detected at concentrations greater than no-effects levels in two stations outside the impoundment perimeter, but detected concentrations exceeded a benthic effects level concentration (the effects range- medium, or ER-M) in only one location, which was within the impoundment perimeter.
- All four PAH compounds correlate strongly and significantly with 2,3,7,8-TCDD and 2,3,7,8-TCDF.

The four PAH compounds should not be analyzed in archived sediments samples because:

- No risk assessment will be performed.

The four PAH compounds should not be analyzed in archived tissue samples because:

- They are not considered to be bioaccumulative (TCEQ 2006) and were therefore not retained as a COPC for human health or fish and wildlife.

The four PAH compounds should not be analyzed in archived soils samples because:

- All four PAH compounds evaluated in sediment correlate strongly and significantly with 2,3,7,8-TCDD and 2,3,7,8-TCDF
- PAH compounds detected in soils collected on the upland sand separation area and in the TxDOT right-of-way did not exceed conservative soil screening levels.

The four PAH compounds will be analyzed in groundwater samples because:

- Detection frequency in sediments was greater than 5 percent.

Phenol

Phenol should be retained as a COPC for assessment of risk to the benthic community because:

- Detection frequency in surface sediments was greater than 5 percent
- Risk could not be evaluated with available information because there is no benthic community screening value for phenol. Additional information on benthic toxicity (to be developed in the risk assessment) is needed.

Phenol should not be analyzed in archived sediment samples because:

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- The only detected values of phenol occurred within the impoundment perimeter. Phenol was not detected in any surface sediment samples outside the impoundment perimeter.
- Although phenol does not correlate with 2,3,7,8-TCDD or 2,3,7,8-TCDF, low detection frequency outside of the impoundments strongly suggests that additional characterization of phenol in sediments is not likely to contribute to selection of a remedy.

Phenol should not be analyzed in archived tissue samples because:

- Phenol is not considered to be bioaccumulative (TCEQ 2006) and was therefore not retained as a COPC for human health or fish and wildlife.

Phenol should not be analyzed in archived soil samples because:

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- The only detected concentrations of phenol occurred within the impoundment perimeter
- Although phenol does not correlate with 2,3,7,8-TCDD and 2,3,7,8-TCDF, available soil data indicate that phenol is not present in soils at concentrations above conservative soil screening levels.

Phenol should be analyzed in groundwater samples because:

- Detection frequency in sediments was greater than 5 percent.

Phenol will be retained as a COPC for the benthic risk assessment, but the evaluation of risk will be conducted using the available data for sediments, because additional information for sediments is unlikely to be useful in the selection of a remedy.

Carbazole

Carbazole should be retained as COPC for assessment of risk to the benthic community because:

- Detection frequency in surface sediments was greater than 5 percent

- Risk could not be evaluated with available information because there is no benthic community screening value for carbazole. Additional information on benthic toxicity (to be developed in the risk assessment) is needed.

Carbazole should not be analyzed in archived sediment samples because:

- Although carbazole has a low (<15 percent) detection frequency and does not correlate with 2,3,7,8-TCDD or 2,3,7,8-TCDF, the highest values of carbazole were in sediments from within the impoundment perimeter
- The spatial pattern of detections and of concentrations strongly suggests that additional information on carbazole is unlikely to contribute to selection of a remedy.

Carbazole should not be analyzed in archived tissue samples because:

- Carbazole is not considered to be bioaccumulative (TCEQ 2006) and was therefore not retained as a COPC for human health or fish and wildlife.

Carbazole should not be analyzed in archived soil samples because:

- Concentrations in soils collected to date are well below conservative screening levels for this chemical.

Carbazole should be analyzed in groundwater samples because:

- Detection frequency in sediments was greater than 5 percent.

Carbazole will be retained as a COPC for the benthic risk assessment, but the evaluation of risk will be conducted using the available data; no additional data are needed for sediments or soils because additional information is unlikely to be useful in the selection of a remedy.

5 ARCHIVED INTERTIDAL SEDIMENT SAMPLES

A subset of the nearshore intertidal sediment samples collected for the RI to evaluate human exposures was analyzed for primary COPCs, and the remaining samples were archived. This section describes an evaluation of the subset that was analyzed to determine whether the archived subset should also be analyzed. The evaluation follows the analytical approach outlined under the DQOs for Study Element 2 in the Sediment SAP (Integral and Anchor QEA 2010). The rules established by the DQOs, a description of the samples to be addressed, methods for the analysis, and conclusions about analysis of archived samples are provided in this section. The chemicals considered in the analysis below are the primary COPCs.

5.1 Guidelines for Analysis and Archived Samples

The DQOs presented in Section 1.10.2 of the Sediment SAP describe the anticipated sampling approach and a series of analytical steps to evaluate the samples. Analyses were designed to identify potential exposure units for use in the human health risk assessment and to determine whether archived surface and subsurface sediment samples should be analyzed. The following decision points were outlined:

- Chemistry data from individual sampling areas that were not statistically different could be pooled to represent a single "exposure unit."
- In the case that the 95 percent upper confidence limit on the mean (95UCL) concentration for a chemical, within a defined exposure unit, exceeds the maximum for the same data set, the dataset is determined to be insufficient to characterize the variability of the chemical within that area. In these cases, archived surface sediment samples should be analyzed. If the maximum is greater than the 95UCL, then additional characterization of the chemistry of those sediments is considered unnecessary. In this latter case, the DQO specified that archived samples should not be analyzed.
- In the case that the reasonable maximum exposure (RME) concentration for any given COPC in surface sediment is lower than its corresponding screening level, the sediment is considered to be sufficiently characterized for the purpose of the risk assessment. In this case archived subsurface samples should not be analyzed. However, if the RME concentration exceeds the screening level, further

characterization of the subsurface sediment is required, and archived subsurface soils should be analyzed.

5.2 Samples

Sediment samples were collected from five human use areas (Integral and Anchor QEA 2010). To simplify this discussion, each of these areas is assigned a letter designation (shown in parentheses and used in subsequent text: see Figure 11). These human use areas are:

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- The shoreline to the west of the shipping berth on the property west of the impoundments (Area A)
- The eastern shoreline of the sand separation area on the property west of the impoundments (Area B)
- The shoreline between the sand separation area and the west side of the impoundments (Area C)
- The shoreline on the east side of the channel under the I-10 Bridge over the San Jacinto River, and downstream (Area D)
- The shoreline of the river channel at the southeast corner of the waste impoundments (Area E).[2]

Figure 11 shows the locations from which surface and subsurface intertidal sediment samples were collected and which were analyzed or archived. Table 10 provides an overview of samples obtained from each location, and the numbers of samples analyzed and archived. At each of Areas A, B, C, and D, 10 distinct locations were sampled at two depth increments: 0 to 6 inches (0 to 15 cm) and 6 to 12 inches (15 to 30 cm) below ground surface. Sediment samples for the initial chemical analyses included five surface samples each from Areas A, B, and C and seven surface samples from Area D. The remaining surface samples (five from Areas A, B, and C, and three from Area D) were archived. Five subsurface samples from Area B and one from Area D were also analyzed. The remaining subsurface samples (10 from

[2] This sampling area was not proposed in the Sediment SAP for the project. However, samples originally proposed for the western shore of the channel beneath the I-10 bridge could not be obtained due to concrete armoring along the shoreline in this area. Consequently, the planned samples were moved to this location. At the time of sampling, the specific uses of this area in exposure evaluation were not considered; therefore, it is considered a separate human use area for the purposes of the analysis described here.

Area A and C, five from Area B, and six from Area D) were archived. Subsurface samples that were analyzed were always associated with a surface sample that was analyzed.

An additional three surface samples were obtained from Area E; these samples were collected as an alternative to samples planned on the west side of the river channel that could not be collected because that shoreline was reinforced with concrete. All three of these were analyzed for primary COPCs and are not subject to the decisions for archived samples being made here. Additionally, due to their proximity to the impoundment, it is hypothesized that the sediment chemistry in this area will differ from that in Areas A, B, C, and D. Therefore, in characterizing the data to determine whether archived samples should be analyzed, it is not appropriate to combine data from this area with the other four beach areas. These samples will be evaluated for the risk assessment along with data extant at the time of the sediment sampling and data collected within the impoundments as part of the soil investigation. They are not considered further for the evaluation here.

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Note that not all of the subsurface samples that we planned were successfully obtained (Table 10, Integral and Anchor QEA 2010). Failure to collect samples during the sediment program occurred due to physical obstructions and was discussed with USEPA during the sampling event. These deviations will be described in the Sediment Field Sampling Report, which is to be included with the PSCR. Analytical results for all sediments are available in the project database.

5.3 Methods

Consistent with the analytical steps and decision logic presented in the DQO for Study Element 2 of the Sediment SAP, the following three steps were conducted:

1. Determination of exposure units
2. Calculation of the 95UCL for each human health COPC.
3. Comparison of a) the 95UCL to maximum concentrations for each exposure unit, and b) the RME concentration for each exposure unit to soil screening levels to determine the need to analyze archived surface and subsurface sediment samples respectively.

The COPCs addressed are the primary COPCs for human health (Table 1). The methods and decision logic for each are described in detail below.

5.3.1 Determination of Exposure Units

Following the approach outlined in the Sediment SAP DQOs, the first step was to determine whether COPC concentrations within any of the individual beach areas were not significantly different than in other beach areas. Sediment chemistry data for beach areas that were not significantly different were combined into exposure units by pooling all data for the two or more areas. Data in each exposure unit was considered collectively for the screening comparisons that occur in the third analytical step.

Non-parametric tests for equivalence (Mann Whitney U test for two sample groups, and Kruskal Wallis test for groups of more than two samples) were employed. Non-parametric tests were used because the small sample sizes for the individual beach areas being compared (i.e., a maximum of seven surface samples per group) did not provide enough information to characterize the data distributions. Statistical tests were run using Statistica 7 software (StatSoft 2005).

The following approach was taken:

- For each combination of two beach areas, Mann Whitney U tests were run for each COPC in order to test the null hypothesis of equivalence. Statistical significance was evaluated at an overall p-value of 0.05 (for the nine individual COPCs a p-value of 0.0056 was used based on the Bonferroni correction for multiple comparisons).
- Following the paired comparison of each combination of two areas, the ability to combine more than two beach areas was considered. For cases where nontransitivity arose from the results of the paired comparisons[3], equivalence between multiple samples was tested using the Kruskal Wallis test. Statistical significance was evaluated at an overall p-value of 0.05 (equivalent to a p-value of 0.0056 for individual COPCs based on Bonferroni correction for multiple comparisons).

[3] If two areas are each equivalent to a third area but they are not equivalent to each other, then the results of the two-sample tests are not transitive. In cases like this, all of the areas were tested together in a single Kruskal-Wallis test to determine whether they were representative of a single population when pooled.

- Groups of samples that were not significantly different were combined into a single exposure unit.

5.3.2 Calculation of 95 Percent Upper Confidence Limits on the Mean

95UCLs were computed for human health COPCs for each dataset as defined by the results of the analysis of exposure units above. USEPA's ProUCL 4.0 program (USEPA 2007a) was used to calculate the 95UCL values. Following USEPA guidance (USEPA 2007b) a 95UCL was not calculated for datasets where fewer than five detected concentrations were available. In these cases, maximum concentrations were used to evaluate the need to analyze archived samples.

5.3.3 Screening To Determine Analysis of Archives

Following the decision points outlined in the sediment DQOs, for each COPC the 95UCL was compared to its respective maximum and sediment screening level to determine whether analysis of archived surface and subsurface samples would be necessary, as follows:

- **Surface Sample Archives**. Where the 95UCL was greater than the maximum detected concentration (indicating significant variability in the dataset), analysis of the archived surface sediment samples may be warranted. In cases in which the 95UCL of the mean was less than the maximum (indicating that the existing data was sufficient to characterize RME estimates), the archived samples will not be analyzed. In the case that no 95UCL was calculated (as described above, for datasets with fewer than five detected values), additional factors, not prescribed in the DQOs, were considered. Specifically, the risk significance of the COPC was considered: in a case where the maximum detected concentration of a COPC fell at least two orders of magnitude below the screening level, the analysis of the archived samples was determined not to be needed.
- **Subsurface Sample Archives**. Where the RME concentration (95UCL where available, or maximum where no 95UCL was calculated) for surface samples that were analyzed was greater than the sediment screening level, archived subsurface sediment samples were considered for analysis. In addition to the rules set forth by the DQOs, some consideration was also given to the relationship between concentrations of COPCs in surface and subsurface sediment and in background sediment data, to add important

context. In cases in which the 95UCL of the mean for surface sediment did not exceed the screening level, archived subsurface samples will not be analyzed.

5.4 Results

Results of each of the analyses required by the DQOs, and additional considerations, are presented in this section, with specific recommendations regarding analysis of archived intertidal sediment samples.

5.4.1 Exposure Units

Figure 12 provides summary statistics to describe the concentrations of each human health COPC in surface sediment across the five beach areas sampled.

Surface sample results for human health COPCs in beach Areas A, B, C, and D were tested for equivalence. Of the six combinations of paired areas, statistical tests indicated that the two sample populations were not significantly different for the human health COPCs in Area A compared to B, Area A compared to C, Area B compared to C, and Area C compared to D (Mann Whitney U tests, $p > 0.0056$). In contrast, comparisons of Areas A and D, and Areas B and D did not support the null hypothesis that samples in these areas were taken from a common distribution (Mann Whitney U tests, $p < 0.0056$ for arsenic, cadmium, chromium, and nickel at Area A compared to D and for cadmium at Area B compared to D).

Next, in order to consider the ability to combine more than two beach areas, for cases where nontransitivity arose from the results of the paired comparisons, statistical tests for multiple samples were completed. The tests indicated that the chemistry at beach Area A and Area D should not be combined with other areas. (Kruskal Wallis test, $p < 0.0056$ for one or more COPCs for area combinations A, C, D; A, B, D; and B, C, D.)

The results of the evaluation for exposure units indicate that for the samples evaluated here three exposure units exist for human receptors: Area A, Area B/C, and Area D. Therefore, subsequent analyses (below) were completed on these exposure units.

5.4.2 Results of Screening to Determine Analysis of Archives

Comparisons of the 95UCLs to maximum concentrations to determine whether additional surface sediment data are needed to characterize the data distributions, and comparisons of the best estimate of the RME concentration for surface samples to sediment screening values to determine whether archived subsurface samples should be analyzed are presented below.

Table 11 presents the sediment screening levels and data summary for the exposure units defined above and used for comparisons to screening levels. The results of the screening step, and the decisions regarding analysis of archived samples in each exposure area, are described in the following sections.

5.4.2.1 Analysis to Determine the Need to Analyze Archived Surface Sediment

Analysis of archived surface sediment is to be carried out if the data are so variable that they cannot be used to make a reliable determination of whether or not concentrations exceed the screening value. Data are considered to be too variable to make this determination if the 95UCL exceeds the maximum value.

Area A. At exposure unit A, the 95UCLs for arsenic, mercury, zinc, and TEQ_{DF} were lower than their respective maximum concentrations. The 95UCLs could not be calculated for COPCs with fewer than five detections or for cadmium, chromium, copper, nickel, and bis(2-ethylhexyl)phthalate (BEHP). In these cases, the variability of the dataset could not be assessed directly. However, for these five COPCs the maximum concentrations were more than 100-fold lower than their respective sediment screening levels. Therefore, despite the relatively high variability, the data are considered to provide a reliable indication that exposure to these COPCs will not contribute significantly to human risk; and it was determined that further characterization of the sediment for these COPCs through archive analysis is not necessary.

Area B/C. At exposure unit B/C, no 95UCL was calculated for cadmium. However, the maximum concentration was more than 200-fold lower than the sediment screening level of 70 mg/kg. For all other COPCs except BEHP, the 95UCL was lower than the maximum concentration. The BEHP results suggest that additional information may be needed to fully characterize BEHP in surface sediments. However, both statistics for BEHP were more than 200 times lower than the sediment screening level. Therefore, despite their variability, the BEHP data are considered to reliably indicate that exposure to BEHP will not contribute significantly to human risk. Additional analysis of archived surface samples in this combined area is not necessary.

Area D. At exposure unit D the 95UCL for all COPCs was lower than the respective maximum concentration.

These results indicate that analysis of archived surface sediment samples in beach areas A, B, C, and D is not necessary.

5.4.2.2 Analysis to Determine the Need to Analyze Archived Subsurface Sediment

To determine whether subsurface sediment archives should be analyzed, the best estimate of an RME exposure (95UCL or, in cases in which no 95UCL was available, the maximum concentration) was compared to the human health screening level for each human health COPC in each defined exposure unit. For those areas within which the RME exposure concentration for all human health COPCs is below the screening level, no analysis of archived subsurface samples is required.

Area A. At exposure unit A, the RME exposure concentrations for all human health COPCs were below the sediment screening level.

Area B/C. At exposure unit B/C, the RME exposure concentration for cadmium, chromium, copper, mercury, nickel, zinc, and BEHP were below their respective screening levels. RME concentrations for arsenic and TEQ_{DF} were higher than the sediment screening level. Based on these results for arsenic and TEQ_{DF}, analysis of archived subsurface samples from Area B/C is further considered below.

Five subsurface samples, were analyzed at locations in Area B from which surface samples were also analyzed. Statistically, the mean concentration of arsenic in these subsurface sediments was not significantly different than those in surface sediments (Wilcoxon matched pairs test, $p > 0.05$). In addition, concentrations of arsenic in background samples obtained from upstream areas as part of the RI sediment investigation were analyzed to determine the REV for arsenic. There are 19 individual samples available for this calculation, and the data are lognormally distributed. The parametric REV is 5.5 mg/kg. The range of arsenic in the intertidal subsurface sediments analyzed is 0.99 to 1.54 mg/kg, all below the REV and within the range of background concentrations. Therefore, additional information on subsurface concentrations of arsenic on the Site is not needed.

For TEQ_{DF}, the RME concentration (95UCL) in Area B/C was 6.4 ng/kg, less than two-fold greater than the conservative[4] soil screening level used in the RI/FS Work Plan of 4.5 ng/kg. The RME concentration is well below the interim PRGs proposed by USEPA for residential and industrial soils of 72 ng/kg and 950 ng/kg respectively (USEPA 2009a). In addition, a statistical evaluation of the subset of locations for which both surface and subsurface sediment samples were analyzed showed no significant difference in concentrations of TEQ_{DF} with depth (Wilcoxon matched pairs test, $p > 0.05$).

Based on these results, available data provide a reliable basis for the human health risk assessment, and it is not necessary to analyze archived subsurface samples in Area B/C.

Area D. At exposure unit D, the 95UCL was below the sediment screening level for all human health COPCs, with the exception of arsenic, for which the 95UCL was 2.43 mg/kg (Table 11). However, this value is lower than the REV based on upstream background samples collected for the RI sediment investigation, which was 5.5 mg/kg, and within the range of background arsenic concentrations. Therefore, additional information on human exposure to arsenic on site is not likely to be gained by analysis of archived intertidal sediments, and concentrations of arsenic in the archived surface sediment for Area D are not a significant data gap. In Area D, there is no need to analyze archived subsurface samples.

[4] USEPA regional screening levels for residential soil were selected for screening sediment. The frequency with which human receptors are likely to come into direct contact with sediment is less than that embedded in the soil screening values. Therefore, these screening values are considered conservative for this evaluation.

The results of the evaluation are summarized in Table 12. These results support no analysis of archived subsurface sediment samples in beach areas A, B, C, and D.

6 SUMMARY

All of the analyses presented in previous sections were conducted according to DQOs established in earlier approved documents. Where this was not possible, either because the DQOs did not anticipate a certain outcome or because the DQO specified a method that was not appropriate to the final results, the rationale for the use of an alternative or additional method was presented. Additional considerations were included in many cases, consistent with statements in earlier documents allowing for the use of additional information. The following provides a brief summary of the findings of analyses presented in this technical memorandum.

- **Comparison of Dioxins and Furans in Sediment: 2005 vs. 2010**—Dioxin and furan concentrations in surface sediments collected within USEPA's preliminary site perimeter in 2010 were significantly different from those in 2005. Therefore, sediment data from 2005 and before should not be included in the baseline data set. Additional discussion and a final determination of the baseline sediment data set will be presented in the PSCR in July 2011.
- **Selection of COPCs, and Analyses in Groundwater and Archived Tissue, Soil, and Sediment**—All chemicals identified as primary COPCs in the Sediment SAP will be addressed in the risk assessments. Secondary COPCs to be addressed in the risk assessments include PCBs, thallium, phenol, and carbazole. The final list of COPCs, and the receptor group(s) for which they will be considered, are presented in Table 13. Secondary COPCs to be evaluated in groundwater include thallium, PCBs (as the sum of Aroclors), acenaphthene, fluorene, naphthalene, phenanthrene, phenol, and carbazole. No additional analyses of archived sediment, tissue, or soils for any chemicals are required.
- **Archived Intertidal Sediment Samples**—No additional analyses of archived intertidal sediment samples are needed to characterize exposure of human receptors to COPCs at the Site. The conclusions and rationale to support this finding are presented in Table 12.

7 REFERENCES

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TABLES

Table 1
Primary and Secondary Chemicals of Potential Concern

Chemical of Interest	Primary COPC	Secondary COPC
Dioxins/Furans		
Dioxins and Furans	E, HH	
Metals		
Aluminum	E	
Arsenic	HH	
Barium	E	
Cadmium	E, HH	
Chromium	HH	
Cobalt	E	
Copper	E, HH	
Lead	E	
Magnesium	E	
Manganese	E	
Mercury	E, HH	
Nickel	E, HH	
Thallium		E
Vanadium	E	
Zinc	E, HH	
Polychlorinated Biphenyls		
Polychlorinated Biphenyls		E, HH
Semivolatile Organic Compounds		
Acenaphthene		E
Fluorene		E
Naphthalene		E
Phenanthrene		E
Phenol		E
Pentachlorophenol		E, HH
Hexachlorobenzene		E, HH
Carbazole		E
Bis(2-ethylhexyl)phthalate	E, HH	
2,4-Dichlorophenol		E
2,4,5-Trichlorophenol		E
2,4,6-Trichlorophenol		E
2,3,4,6-Tetrachlorophenol		E, HH

Notes
COPC = chemical of potential concern
E = ecological receptors
HH = human health receptors

Table 2
Sediment Datasets for the San Jacinto River Waste Pits Site

Source of Sediment Chemistry Data	Sampling Dates	Chemicals Analyzed	Area Sampled	Reference
San Jacinto River Waste Pits Site Sampling to support the RI/FS	May and October 2010	Dioxins/Furans, Metals, PAH, SVOCs, PCBs, VOCs	182 stations in the San Jacinto River within, adjacent to, and upstream of USEPA's preliminary Site perimeter to support nature and extent, characterization of waste materials and human and ecological risk assessment efforts.	Integral and Anchor QEA (2010)
TCEQ Site Sampling	August 20, 2009	Dioxins/Furans	Four sediment stations (five samples, of which one was a field duplicate) and three surface water samples in Site, within and adjacent to impoundments	URS (2010)
TCEQ TMDL Study	May to August 2009	PCBs (congeners)	35 stations along the HSC and in the San Jacinto River. One sample was taken within the site downstream of the impoundment (11193) and one sample was taken upstream of the site (16622).	Koenig (2010, Pers. Comm.)
TCEQ TMDL Study	April to July 2008	PCBs (congeners)	70 stations along the HSC, in the San Jacinto River, and down to Galveston Bay. One sample was taken within the site downstream of the impoundment (11193) and one sample was taken upstream of the site (16622).	University of Houston and Parsons (2008)
Texas Department of Transportation Dolphin Project	May to June 2006	Dioxins/Furans, Metals, SVOCs, PCBs (Aroclors)	Four sediment cores and eight surface sediment samples in San Jacinto River just upstream of Interstate Highway 10	Weston (2006)
TCEQ Site Screening Investigation	July 2005	Dioxins/Furans, Metals, PAH, SVOCs, Pesticides, PCBs (Aroclors)	Six stations in the Impoundments (seven samples, of which one was a field duplicate), three stations downstream and within the Site, additional upstream and downstream background locations outside of the Site	TCEQ and USEPA (2006)
TCEQ TMDL Study	2002 to 2005	Dioxins/Furans	Sampling throughout the HSC; one station adjacent to the Site (11193) sampled for surface sediment multiple times (this is a monitoring station), and 1 core sample collected in 2004; 21 additional surface sediment samples on Site collected in August 2005	University of Houston and Parsons (2006)
HSC Toxicity Study	August and October 1993; May 1994	Dioxins/Furans	35 Stations along the HSC and major tributaries; two stations are located in the Site, one in the channel adjacent to the impoundments and one upstream of waste pits	ENSR and EHA (1995)

Notes

HSC = Houston Ship Channel
PAH - polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
TCEQ = Texas Commission on Environmental Quality
TMDL = total maximum daily load

Table 3

SWACs and Results of Statistical Comparisons of Concentrations of Each Dioxin and Furan Congener: 2005 vs. 2010

	SWAC (ng/kg)		*p*-value	
Analyte	**2005**	**2010**	**MWW test**	**K-S test**
2,3,7,8-TCDD	97.2	18.3	< 0.05	< 0.05
1,2,3,7,8-PeCDD	1.60	0.160	< 0.05	< 0.05
1,2,3,4,7,8-HxCDD	1.15	0.119	< 0.05	< 0.05
1,2,3,6,7,8-HxCDD	1.67	0.399	< 0.05	< 0.05
1,2,3,7,8,9-HxCDD	1.83	0.524	< 0.05	< 0.05
1,2,3,4,6,7,8-HpCDD	60.1	20.1	< 0.05	< 0.05
OCDD	1850	720	< 0.05	< 0.05
2,3,7,8-TCDF	311	68.6	< 0.05	< 0.05
1,2,3,7,8-PeCDF	13.3	1.35	< 0.05	< 0.05
2,3,4,7,8-PeCDF	10.4	1.03	< 0.05	< 0.05
1,2,3,4,7,8-HxCDF	22.1	2.56	< 0.05	< 0.05
1,2,3,6,7,8-HxCDF	6.39	0.651	< 0.05	< 0.05
1,2,3,7,8,9-HxCDF	2.51	0.0932	< 0.05	< 0.05
2,3,4,6,7,8-HxCDF	1.80	0.131	< 0.05	< 0.05
1,2,3,4,6,7,8-HpCDF	10.0	2.57	< 0.05	< 0.05
1,2,3,4,7,8,9-HpCDF	2.62	0.309	< 0.05	< 0.05
OCDF	37.7	21.9	< 0.05	< 0.05
Total D/F	2440	859	< 0.05	< 0.05

Notes:

K-S = Kolmogorov-Smirnov

MWW = Mann Whitney Wilcoxon

SWAC = spatially-weighted average concentration

Table 4
Detection Frequencies of Secondary COPCs in Surface Sediment Collected in 2010

Analyte	Secondary COPC: Human Health	Secondary COPC: Benthic	Secondary COPC: Fish and Wildlife	Detection Frequency	Decision Resulting From Detection Frequency
Metals					
Thallium		x		11/126 (9%)	Enter risk-based screens
PCBs					
Total PCB D/F-like congeners	x		x	26/27 (96%)	Enter risk-based screens
PCB077	x		x	15/27 (56%)	Enter risk-based screens
PCB081	x		x	5/27 (19%)	Enter risk-based screens
PCB105	x		x	23/27 (85%)	Enter risk-based screens
PCB114	x		x	15/27 (56%)	Enter risk-based screens
PCB118	x		x	22/27 (81%)	Enter risk-based screens
PCB123	x		x	15/27 (56%)	Enter risk-based screens
PCB126	x		x	3/27 (11%)	Enter risk-based screens
PCB156+157 [a]	x		x	22/27 (81%)	Enter risk-based screens
PCB167	x		x	18/27 (67%)	Enter risk-based screens
PCB169	x		x	1/27 (4%)	Enter risk-based screens[b]
PCB189	x		x	13/27 (48%)	Enter risk-based screens
SVOCs					
2,3,4,6-Tetrachlorophenol	x	x		0/28 (0%)	Never detected; not a COPC
2,4,5-Trichlorophenol		x		0/28 (0%)	Never detected; not a COPC
2,4,6-Trichlorophenol		x		0/28 (0%)	Never detected; not a COPC
2,4-Dichlorophenol		x		0/28 (0%)	Never detected; not a COPC
Acenaphthene		x		6/28 (21%)	Enter risk-based screens
Carbazole		x		4/28 (14%)	Enter risk-based screens
Hexachlorobenzene	x	x	x	0/28 (0%)	Never detected; not a COPC
Fluorene		x		11/28 (39%)	Enter risk-based screens
Naphthalene		x		9/28 (32%)	Enter risk-based screens
Phenanthrene		x		17/28 (61%)	Enter risk-based screens
Pentachlorophenol	x	x	x	0/28 (0%)	Never detected; not a COPC
Phenol		x		5/28 (18%)	Enter risk-based screens

Notes:

COPC = chemical of potential concern
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound

a - The two congeners are shown together because they co-elute.
b - Detection frequency is <5 percent for this congener, but congener carried forward with other D/F-like congeners for completeness.

Table 5
Human Health Risk-Based Screening for Secondary COPCs

Secondary COPC Entering Risk-Based Screen	Screening Level (µg/kg dry weight) [a]	Maximum Detected Site Concentration (µg/kg dry weight)	Does Maximum Site Value Exceed Screening Level?	Is Chemical Potentially Bioaccumulative from Sediment? [b]
Total PCB D/F congeners [c]	220	356 [d]	Yes	Yes
PCB077	34	2.58	No	Yes
PCB081	11	0.032	No	Yes
PCB105	110	76.6	No	Yes
PCB114	110	7.75	No	Yes
PCB118	110	197	Yes	Yes
PCB123	110	4.21	No	Yes
PCB126	0.034	0.065	Yes	Yes
PCB156+157 [e]	110	51.4	No	Yes
PCB167	110	14.9	No	Yes
PCB169	0.11	0.065	No	Yes
PCB189	110	1.70	No	Yes

Notes:

COPC = chemical of potential concern

PCB = polychlorinated biphenyl

a - Screening level for total PCBs as provided in Appendix C of the Sediment SAP. Source for total PCB and PCB congener screening levels is USEPA (2010) Regional Screening Levels, which are available at: http://www.epa.gov/reg3hwmd/risk/human/index.htm.

b - Determination of bioaccumulative potential was made consistent with TCEQ guidance (TCEQ 2006).

c - Only dioxin-like congeners were analyzed in sediments. The value is the sum of these congeners.

d - Exceedence of this screening level occurred at a single location and within the impoundments (station SJGB014) (see Figure 9).

e - Concentration shown is the sum of the two congeners because these two samples co-elute. Screening value shown is for each congener individually.

Table 6
Benthic Invertebrate Community Risk-Based Screening for Secondary COPCs

	Secondary COPC Entering Risk-Based Screen	NOAEL[a]	LOAEL[b]	Maximum Detected Site Concentration	Does Maximum Site Value Exceed NOAEL?	Does Maximum Site Value Exceed LOAEL?
Metals (mg/kg)						
	Thallium	NV	NV	20.7 (J)	--	--
SVOCs (μg/kg)						
	Acenaphthene	16	500	780 (J)	Yes	Yes
	Fluorene	19	540	810 (J)	Yes	Yes
	Naphthalene	160	2,100	370 (J)	Yes	No
	Phenanthrene	240	1,500	1,500	Yes	No
	Phenol	NV	NV	170 (J)	--	--
	Carbazole	NV	NV	73 (J)	--	--

Notes:

COPC = chemical of potential concern

J = estimated value

NV = no value

SVOC = semivolatile organic compound

-- = Not applicable, no screening value available

a - NOAEL (no-observed-adverse-effect-level) is from TCEQ (2006) and is based on Long et al. (1995)

b - LOAEL (lowest-observed-adverse-effect level) is the ER-M from Long et al. (1995)

Table 7 place holder for southern impoundment

Average Percent Contribution of Each Dioxin and Furan Congener to the Total Dioxins and Furans[a] Within and Outside of the Impoundments[b]

Analyte	Within the Impoundments	Outside of the Impoundments
2,3,7,8-TCDD	16%	1.6%
1,2,3,7,8-PeCDD	0.13%	0.03%
1,2,3,4,7,8-HxCDD	0.01%	0.03%
1,2,3,6,7,8-HxCDD	0.02%	0.07%
1,2,3,7,8,9-HxCDD	0.02%	0.07%
1,2,3,4,6,7,8-HpCDD	0.86%	2.8%
OCDD	22%	86%
2,3,7,8-TCDF	51%	5.7%
1,2,3,7,8-PeCDF	1.9%	0.13%
2,3,4,7,8-PeCDF	1.1%	0.09%
1,2,3,4,7,8-HxCDF	3.8%	0.22%
1,2,3,6,7,8-HxCDF	0.87%	0.06%
1,2,3,7,8,9-HxCDF	0.04%	0.02%
2,3,4,6,7,8-HxCDF	0.1%	0.03%
1,2,3,4,6,7,8-HpCDF	1.1%	0.36%
1,2,3,4,7,8,9-HpCDF	0.4%	0.05%
OCDF	0.9%	2.8%
Total	100%	100%

a - "Total dioxins and furans" is the sum of concentrations of the 17 congeners.

b - Percentages were calculated using only sediment samples collected from within USEPA's preliminary site perimeter in 2010. Percentages were calculated for each sample and averaged within each group.

Table 8
Results of Analysis of Correlations Between Each Secondary COPC and 2,3,7,8-TCDD and 2,3,7,8-TCDF

	2,3,7,8-TCDD		2,3,7,8-TCDF	
COPC	**Tau-b**	***p*-Value**	**Tau-b**	***p*-Value**
Thallium	0.1	**0.03**	0.1	**0.04**
Total PCBs	0.2	**<0.01**	0.2	**<0.01**
Dioxin-like PCB congeners				
PCB77	0.6	**<0.01**	0.6	**<0.01**
PCB81	0.3	0.06	0.3	0.06
PCB105	0.8	**<0.01**	0.8	**<0.01**
PCB114	0.7	**<0.01**	0.7	**<0.01**
PCB118	0.8	**<0.01**	0.8	**<0.01**
PCB123	0.7	**<0.01**	0.7	**<0.01**
PCB126	0.1	0.26	0.2	0.22
PCB156/157	0.8	**<0.01**	0.8	**<0.01**
PCB167	0.7	**<0.01**	0.7	**<0.01**
PCB169	0.1	0.70	0.1	0.67
PCB189	0.7	**<0.01**	0.7	**<0.01**
Acenaphthene	0.3	**0.03**	0.3	**0.02**
Fluorene	0.5	**<0.01**	0.5	**<0.01**
Naphthalene	0.5	**<0.01**	0.5	**<0.01**
Phenanthrene	0.6	**<0.01**	0.6	**<0.01**
Phenol	0.2	0.06	0.3	**0.04**
Carbazole	0.1	0.61	0.1	0.60

Notes:

COPC = chemical of potential concern

2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzo-*p*-dioxin

2,3,7,8-TCDF = 2,3,7,8-tetrachlorodibenzofuran

Table 9
Summary Results of All Analyses for Each Secondary COPC

Analyte	Receptor Group for Which Chemical Is a Secondary COPC in the RI/FS Work Plan: Human Health	Benthic	Fish and Wildlife	Detected in more than 5 percent of samples?	Risk-Based Screening: Human Health: Exceeds Screening Level (E) or is Bioaccumulative (B)	Eco/Benthic: Exceeds Screening Level	Eco/Wildlife: Is Bioaccumulative	Correlates with 2,3,7,8-TCDD or 2,3,7,8-TCDF	Conclusion
Metals									
Thallium		x		Yes		No SL		No	No further analysis in sediment, soil or tissue. Analysis in groundwater.[a]
PCBs									
PCBs	x		x	Yes	E, B	No	B	No	No further analysis in sediment or soil; analysis of congeners in tissue; analysis of total PCBs (sum of Aroclors) in groundwater[a]
PCB 77	x		x	Yes	B	No SL	B	Yes	
PCB 81	x		x	Yes	B	No SL	B	No	
PCB 105	x		x	Yes	B	No SL	B	Yes	
PCB 114	x		x	Yes	B	No SL	B	Yes	
PCB 118	x		x	Yes	E, B	No SL	B	Yes	
PCB 123	x		x	Yes	B	No SL	B	Yes	
PCB 126	x		x	Yes	E, B	No SL	B	No	
PCB 156/157	x		x	Yes	B	No SL	B	Yes	
PCB 167	x		x	Yes	B	No SL	B	Yes	
PCB 169	x		x	No	B	No SL	B	No	
PCB 189	x		x	Yes	B	No SL	B	Yes	
SVOCs									
2,3,4,6-Tetrachlorophenol	x	x		No	NA	NA	NA	NA	Not a COPC, detected ≤5 percent of surface sediment samples
2,4,5-Trichlorophenol		x		No	NA	NA	NA	NA	Not a COPC, detected ≤5 percent of surface sediment samples
2,4,6-Trichlorophenol		x		No	NA	NA	NA	NA	Not a COPC, detected ≤5 percent of surface sediment samples
2,4-Dichlorophenol		x		No	NA	NA	NA	NA	Not a COPC, detected ≤5 percent of surface sediment samples
Acenaphthene		x		Yes	NA	Yes	NA	No	No further analysis in sediment, soil or tissue. Analysis in groundwater.[a]
Carbazole		x		Yes	NA	No SL	NA	No	No further analysis in sediment, soil or tissue. Analysis in groundwater.[a]
Hexachlorobenzene	x	x	x	No	B	NA	B	NA	Not a COPC, detected ≤5 percent of surface sediment samples
Fluorene		x		Yes	NA	Yes	NA	Yes	No further analysis in sediment, soil or tissue. Analysis in groundwater.[a]
Naphthalene		x		Yes	NA	Yes	NA	Yes	No further analysis in sediment, soil or tissue. Analysis in groundwater.[a]
Phenanthrene		x		Yes	NA	Yes	NA	Yes	No further analysis in sediment, soil or tissue. Analysis in groundwater.[a]
Pentachlorophenol	x	x	x	No	B	NA	B	NA	Not a COPC, detected ≤5 percent of surface sediment samples
Phenol		x		Yes	NA	No SL	NA	No	No further analysis in sediment, soil or tissue. Analysis in groundwater.[a]

Notes:

NA - Not applicable, either the chemical was detected in ≤5 percent of surface sediment samples, or was not a COPC for this receptor group

COPC = chemical of potential concern

PCB = polychlorinated biphenyl

2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzo-*p*-dioxin

2,3,7,8-TCDF = 2,3,7,8-tetrachlorodibenzofuran

a - Considerations in addition to those shown here were made in developing this conclusion. See text Sections 4.1.4 and 4.2.

place marker southern impoundments

Table 10
Summary of Nearshore Sediment Samples for Exposure Assessment

Beach Area	Description of Area	Samples Obtained	Samples Analyzed	Archived Samples
A	Shoreline to the west of the shipping berth on the property west of the impoundments	10 surface and 10 subsurface (SJSH036 to -45)	5 surface (SJSH036, -038, -040, -042, -044) No subsurface	5 surface (SJSH037, -039, -041, -043, -045) 10 subsurface (SJSH036 to -45)
B	Eastern shoreline of the sand separation area on the property west of the impoundments	10 surface and 10 subsurface (SJSH026 to -35)	5 surface (SJSH027, -029, -031, -033, -035) 5 subsurface (SJSH027, -029, -031, -033, -035)	5 surface (SJSH026, -028, -030, -032, -034) 5 subsurface (SJSH026, -028, -030, -032, -034)
C	Shoreline between the sand separation area and the west side of the impoundments	10 surface and 10 subsurface (SJSH016 to -25)	5 surface (SJSH017, -019, -021, -023, -025) No subsurface	5 surface (SJSH016, -018, -020, -022, -024) 10 subsurface (SJSH016 to -25)
D	Shoreline on the east side of the channel under the I-10 Bridge over the San Jacinto River, and downstream	10 surface (SHSH001 to -005; -011 to -015) 7 subsurface (SJSH003, -005, -011 to -015)	7 surface (SJSH001, -002, -003, -004, -005, -012, -014) 1 subsurface (SJSH014)	3 surface (SJSH011, -013, -015) 6 subsurface (SJSH003, -005, -011, -012, -013, -015)
E	The embayment to the southeast corner of the waste pits	3 surface (SHSH008 to -010) No subsurface	3 surface (SJSH008 to -010)	None

Table 11
Screening Levels and Data Summary for Human Health COPCs at Defined Exposure Units

Analyte	Sediment Screening Level[a]	Exposure Unit A				Exposure Unit B/C				Exposure Unit D			
		FOD	Maximum	95UCL	UCL Basis	FOD	Maximum	95UCL	UCL Basis	FOD	Maximum	95UCL	UCL Basis
Metals (mg/kg)													
Arsenic	0.39	5/5	0.39	0.32	95% Student's t UCL	10/10	3.63	**2.13**	95% Student's t UCL	7/7	2.95	**2.43**	95% Student's t UCL
Cadmium	70	0/5	0.1	NC	--	4/10	0.27	NC	95% KM (t) UCL	7/7	0.58	0.43	95% Student's t UCL
Chromium[b]	120,000	4/5	0.830	NC	--	10/10	35.7	21.7	95% Chebyshev (mean, s.d.) UCL	7/7	13.1	8.33	95% Student's t UCL
Copper	3,100	2/5	3.5	NC	--	10/10	9.3	7.0	95% Student's t UCL	7/7	10.4	7.88	95% Student's t UCL
Mercury	23	5/5	0.014	0.010	95% Student's t UCL	8/10	0.0235	0.0154	95% Student's t UCL	6/7	0.05	0.04	95% Student's t UCL
Nickel	1,500	1/5	0.425	NC	--	10/10	12.5	6.69	95% Student's t UCL	7/7	6.82	6.50	95% Student's t UCL
Zinc	23,000	5/5	9	6.76	95% Student's t UCL	10/10	55.4	48.1	95% Chebyshev (mean, s.d.) UCL	7/7	66.4	45.8	95% Student's t UCL
Dioxins (ng/kg)													
TEQ_{DF} - 1/2DL	4.5	5/5	0.495	0.456	95% Student's t UCL	10/10	10.9	**6.36**	95% Student's t UCL	7/7	2.90	2.12	95% Student's t UCL
SVOCs (μg/kg)													
BEHP	35,000	0/5	9.5	NC	--	5/10	120	*155*	99% Chebyshev (mean, s.d.) UCL	5/7	73	49	95% Student's t UCL

Notes:

Bold text indicates that 95UCLs exceed the screening level. Where no 95UCL was calculated, maximum concentrations were compared to screening levels, and exceedences highlighted.

Italic text indicates that the 95UCL exceeds the maximum concentration.

-- = Not applicable

FOD = frequency of detection

NC = Not calculated, USEPA ProUCL advises against computing 95UCLs for data sets with fewer than five detected data points.

RSL = residential screening level

s.d. = standard deviation

SVOC = semivolatile organic compound

UCL = upper confidence limit

Exposure Unit A is made up of the following locations: SJSH036, -038, -040, -042, and -044.

Exposure Unit B/C is made up of the following locations: SJSH017, -019, -021, -023, -025, -027, -029, -031, -033, and -035.

Exposure Unit D is made up of the following locations: SJSH001, -002, -003, -004, -005, -012, and -014.

a - Sediment screening levels are USEPA RSLs for residential soil as specified in the Sediment SAP (Integral and Anchor QEA 2010).

b - Value for chromium is for chromium(III). Value for chromium(VI) is lower.

Table 12
Results of Screening to Determine Analysis of Archived Surface and Subsurface Samples

Samples	Beach Area	Exposure Unit	Archive Analysis Determination and Rationale
Archived Surface Samples			
SJSH037, -039, -041, -043, -045	A	A	Analysis of archived samples is not required. 95UCLs for exposure unit < maximum for arsenic, mercury, zinc, and TEQ_{DF}. No 95UCL was calculated for remaining COPCs due to low frequency of detection; however, maximum levels are much lower than the screening levels.
SJSH026, -028, -030, -032, -034	B	B/C	Analysis of archived samples is not required. 95UCLs within the exposure unit for majority of COPCs < maximums. Exceptions are no 95UCL for cadmium due to low frequency of detection and 95UCL for BEHP exceeds maximum; however, maximum levels of each are only 1/200 the screening levels. Any variability in the data does not prevent a reliable risk assessment decision from being made.
SJSH016, -018, -020, -022, -024	C		
SJSH011, -013, -015	D	D	Analysis of archived samples is not required. 95UCLs for exposure unit < maximum for all COPCs.
Archived Subsurface Samples			
SJSH036 to -045	A	A	Analysis of archived samples is not required. 95UCLs or maximums a < sediment screening level.
SJSH026, -028, -030, -032, -034	B	B/C	Analysis of archived samples is not required. 95UCLs < sediment screening level for all human health COPCs with the exception of arsenic and TEQ_{DF}. Based on additional considerations discussed in Section 5.4.2 of the text, the minimal amount of arsenic and TEQ_{DF} data in subsurface sediment is not a significant data gap.
SJSH016 to -25	C		
SJSH003, -005, -011, -012, -013, -015	D	D	Analysis of archived samples is not required. 95UCLs < sediment screening level for all human health COPCs with the exception of arsenic. Based on additional considerations discussed in Section 5.4.2 of the text, the minimal amount of arsenic data in subsurface sediment is not a significant data gap.

Notes:

BEHP - bis(ethyl)hexyl phthalate
COPC = chemical of potential concern
TEQ_{DF} = toxcity equivalent for dioxins and furans

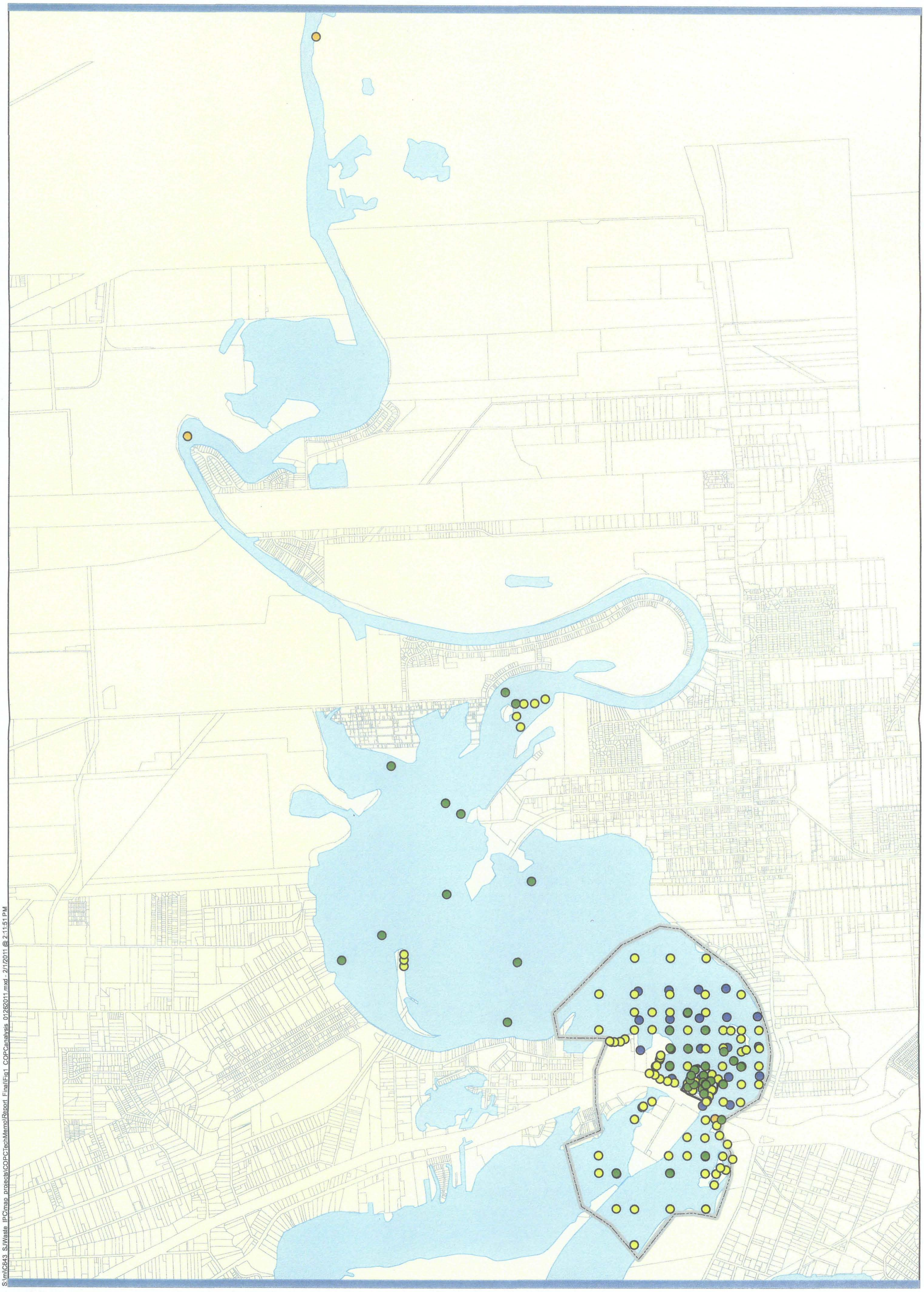
a - Screening was completed using 95UCLs where available; when no 95UCL was available, maximum concentrations were used.

Table 13
Final Chemicals of Potential Concern

Chemical	COPC Designation
Dioxins/Furans	
Dioxins and Furans	EB,EFW, HH
Metals	
Aluminum	EB
Arsenic	HH
Barium	EB
Cadmium	EFW, HH
Chromium	HH
Cobalt	EB
Copper	EB, EFW, HH
Lead	EB
Magnesium	EB
Manganese	EB
Mercury	EB, EFW, HH
Nickel	EFW, HH
Thallium	EB
Vanadium	EB
Zinc	EB, EFW, HH
Polychlorinated Biphenyls	
Polychlorinated Biphenyls	EFW, HH
Semivolatile Organic Compounds	
Phenol	EB
Carbazole	EB
Bis(2-ethylhexyl)phthalate	EB, EFW, HH

Notes
COPC = chemical of potential concern
EFW = ecological receptors - fish and wildlife
EB = ecological receptors - benthic invertebrate community
HH = human health receptors

FIGURES



ANCHOR QEA integral consulting inc.

Surface Sediment Sample Stations

- 2010 Samples Analyzed for Primary COPCs
- 2010 Samples Analyzed for Primary and Secondary COPCs
- TMDL Monitoring Stations
- 2005 TMDL Sediment Sample Stations Analyzed for Dioxins and Furans
- Original (1966) Perimeter of the Northern Impoundments
- Preliminary Site Perimeter
- Parcel Boundary

0 5,000

Feet

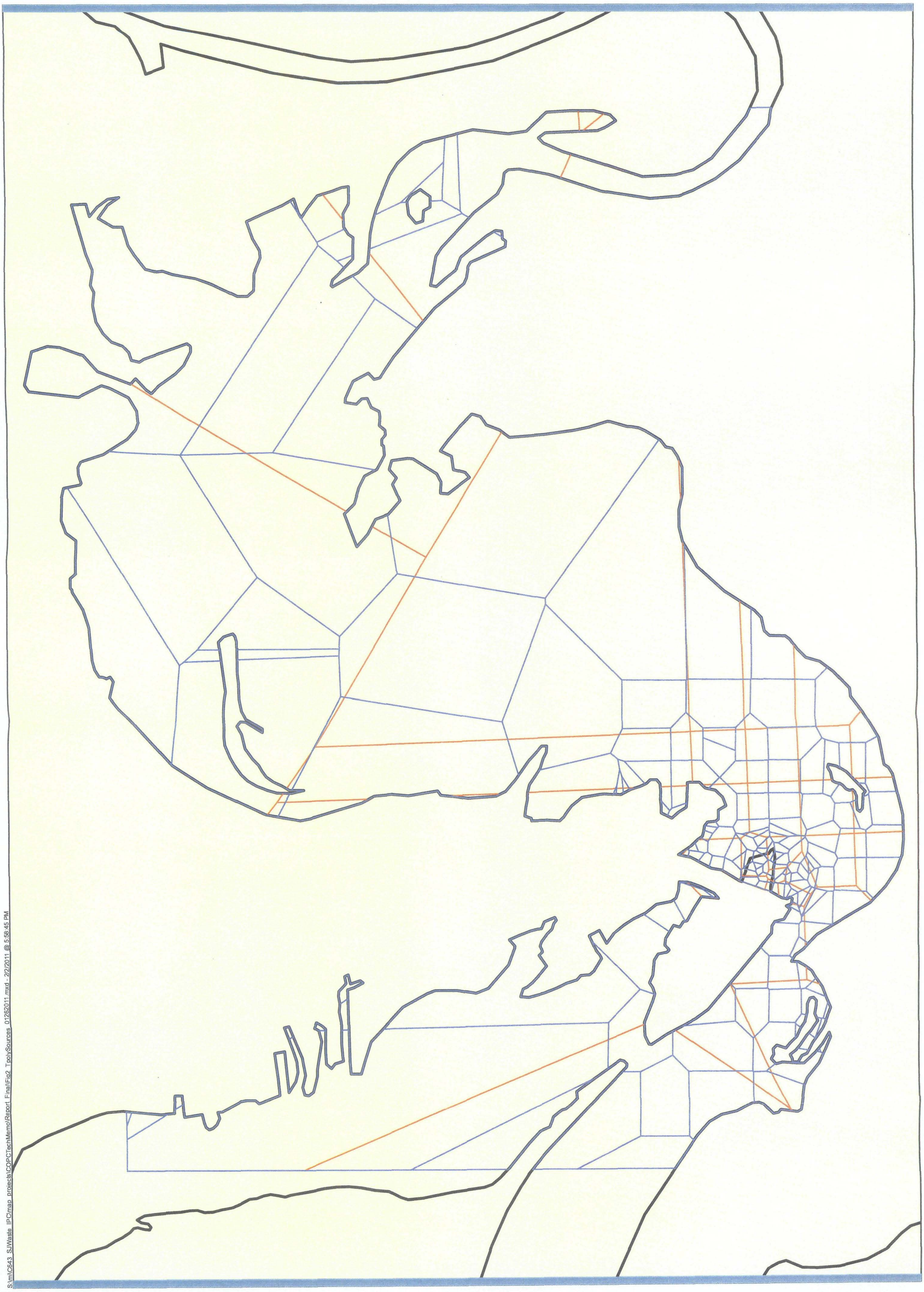
DRAFT

Figure 1

Locations of Surface Sediment Samples

COPC Technical Memorandum

SJRWP Superfund/MIMC and IPC



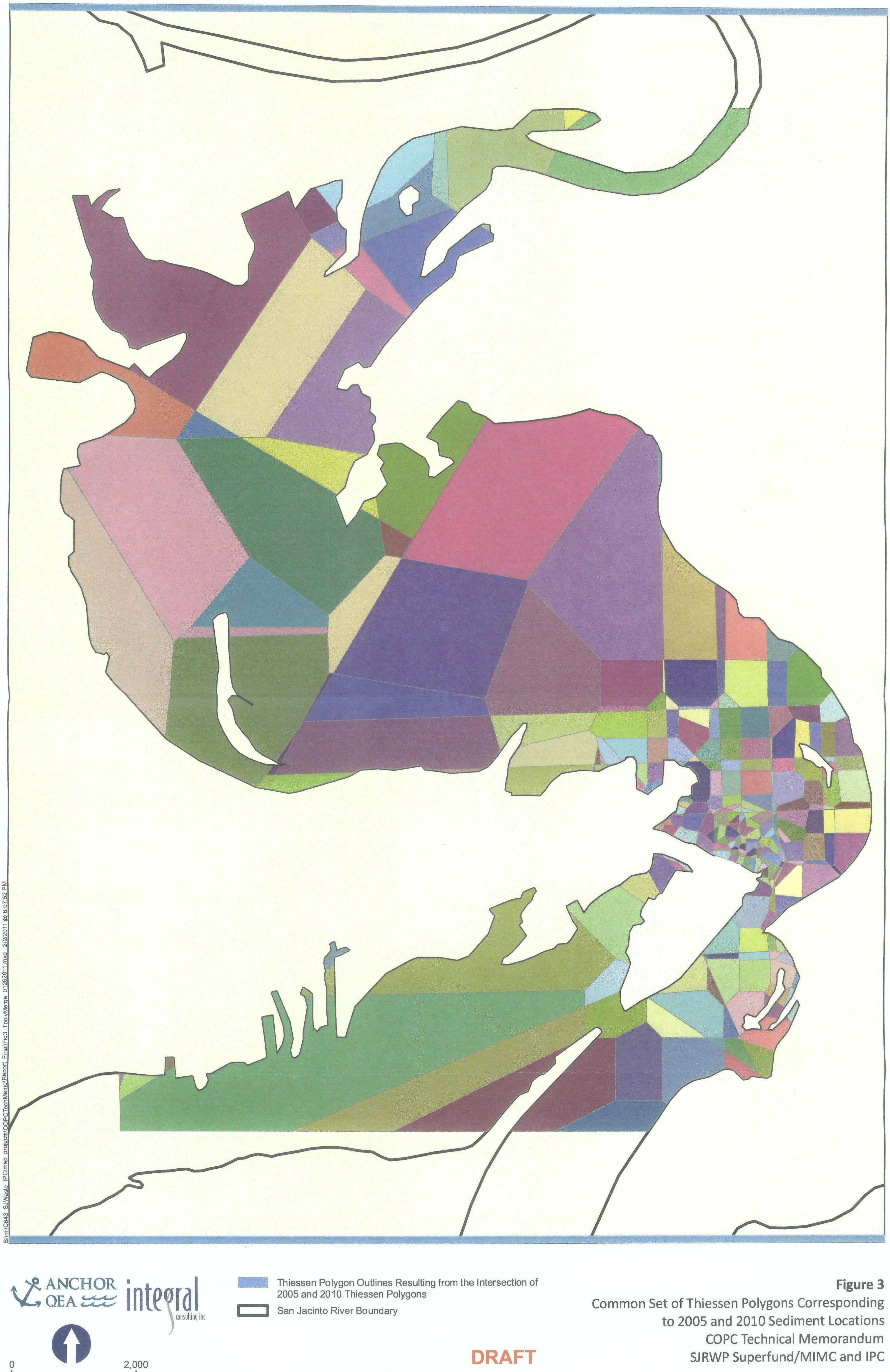
ANCHOR QEA integral consulting inc.

Thiessen Polygon Outlines Based on 2010 Sampling
Thiessen Polygon Outlines Based on 2005 Sampling
San Jacinto River Boundary

0 2,000
Feet

Figure 2
Thiessen Polygons for 2005 and 2010
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC

DRAFT



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integral consulting inc.

Thiessen Polygon Outlines Resulting from the Intersection of 2005 and 2010 Thiessen Polygons

San Jacinto River Boundary

0 2,000

Feet

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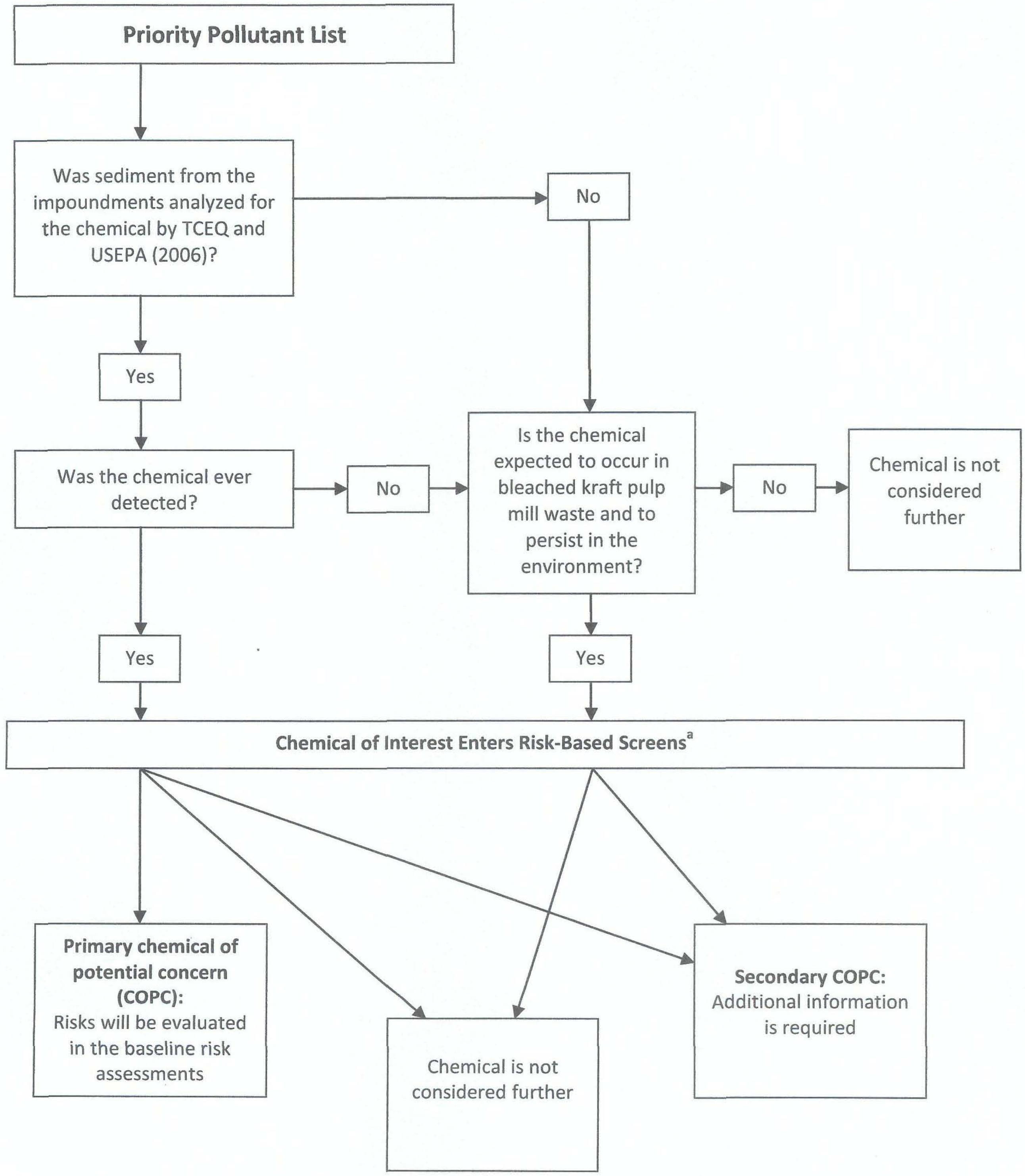
Figure 3

Common Set of Thiessen Polygons Corresponding to 2005 and 2010 Sediment Locations

COPC Technical Memorandum

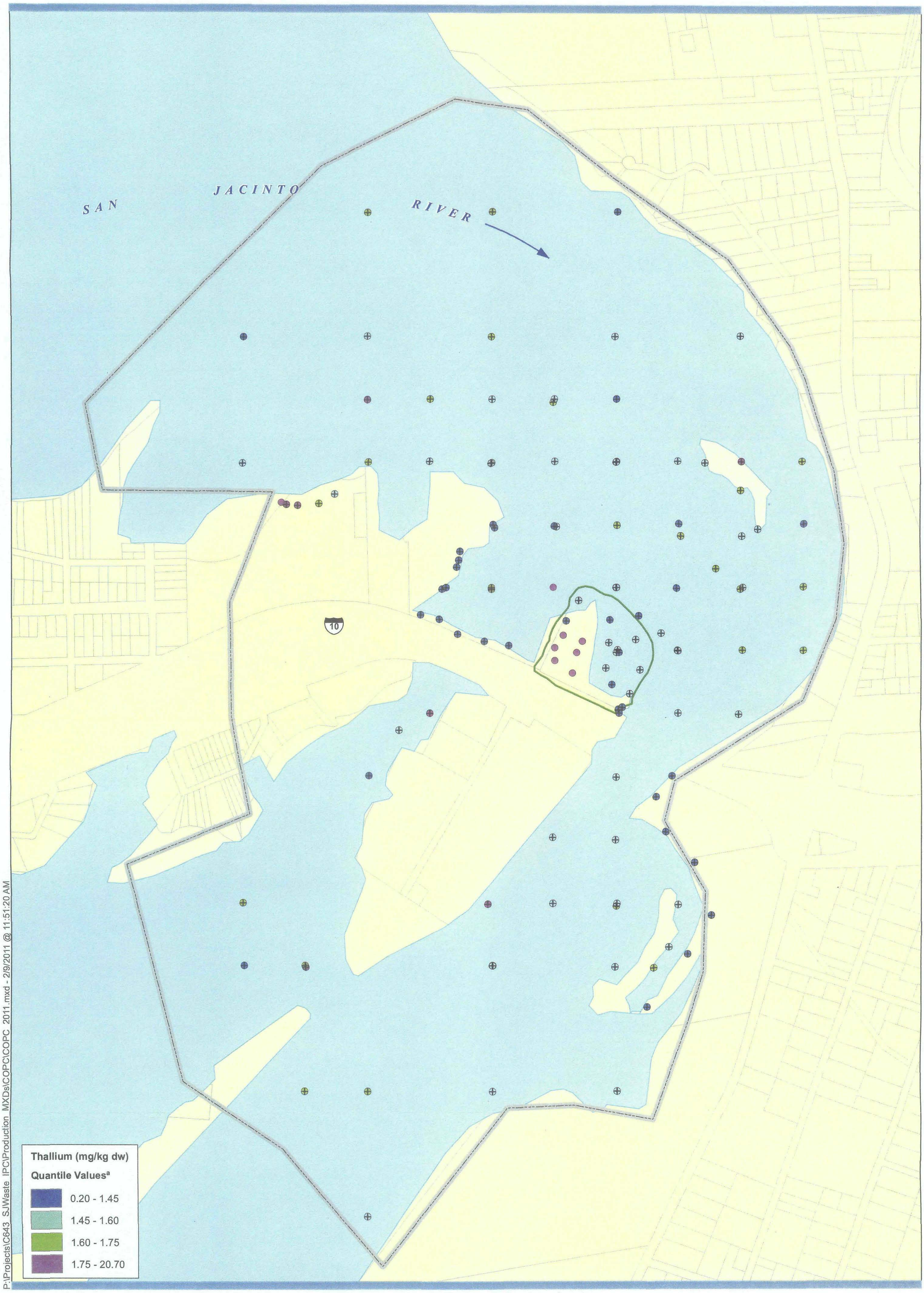
SJRWP Superfund/MIMC and IPC



[a]**Chemicals of Interest** are those that will enter the risk-based screening process. Three separate risk-based screens will be used: a) fish and wildlife, b) benthic invertebrates, and c) human health.

ANCHOR QEA integral consulting inc.

Figure 4
Process for Selection of Chemicals of Interest to the RI/FS
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC



ANCHOR QEA integral consulting inc.

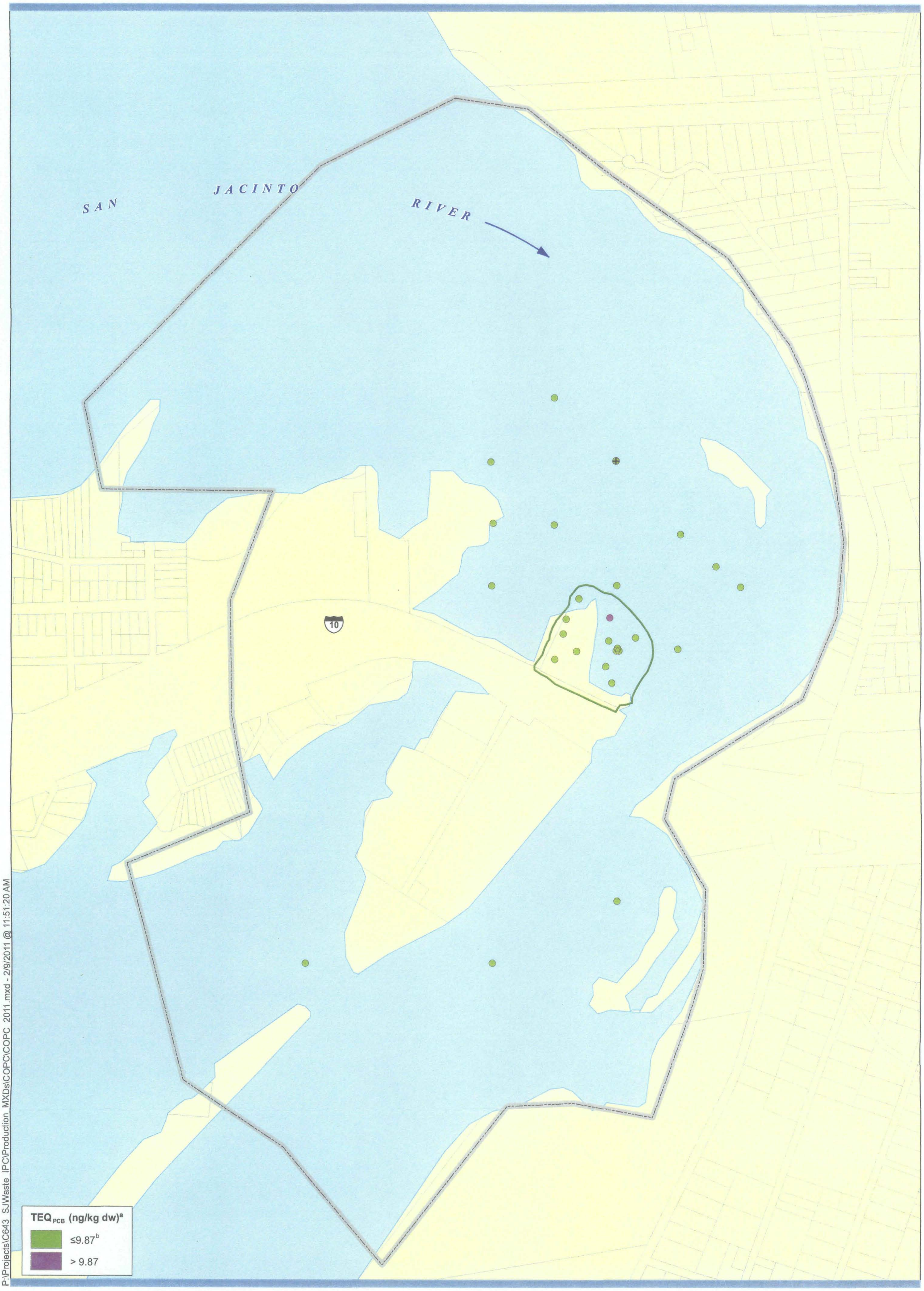
0 800
Scale in Feet

DRAFT

[a]No Ecological or Human Health Screening Level

Preliminary Site Perimeter
Original (1966) Perimeter of the Northern Impoundments
Parcel Boundary
RI Sediment Station
RI Sediment Station (Non-Detect)

Figure 5
Thallium in Surface Sediments
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC



ANCHOR QEA integral consulting inc.

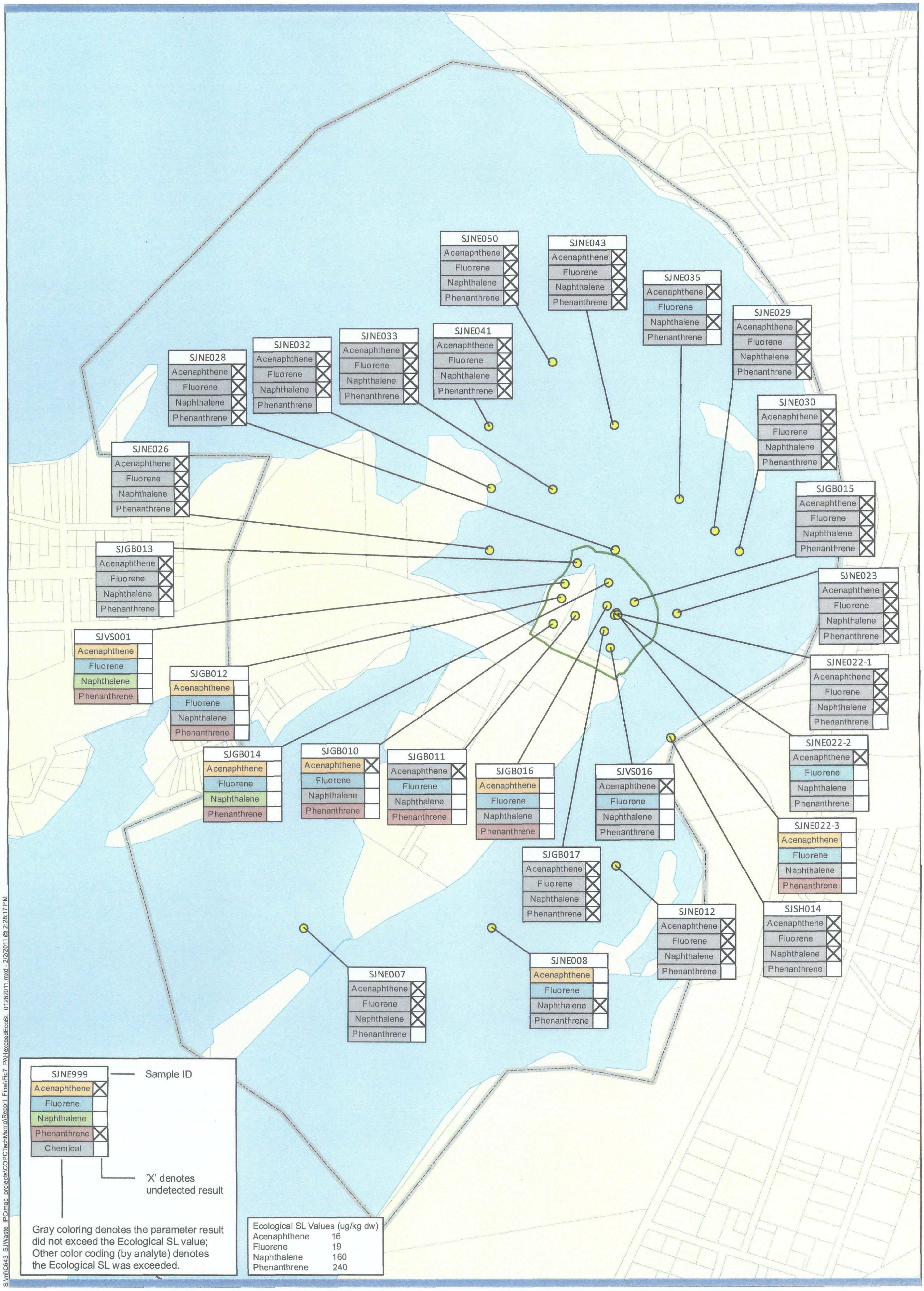
0 800 Scale in Feet

DRAFT

[a]No Ecological or Human Health Screening Level
[b]9.87 ng/kg is the reference envelope value for TEQ$_{PCB}$ calculated using only upstream samples.

Preliminary Site Perimeter
Original (1966) Perimeter of the Northern Impoundments
Parcel Boundary
RI Sediment Station
RI Sediment Station (Non-Detect)

Figure 6
TEQ$_{PCB}$ in Surface Sediments
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC



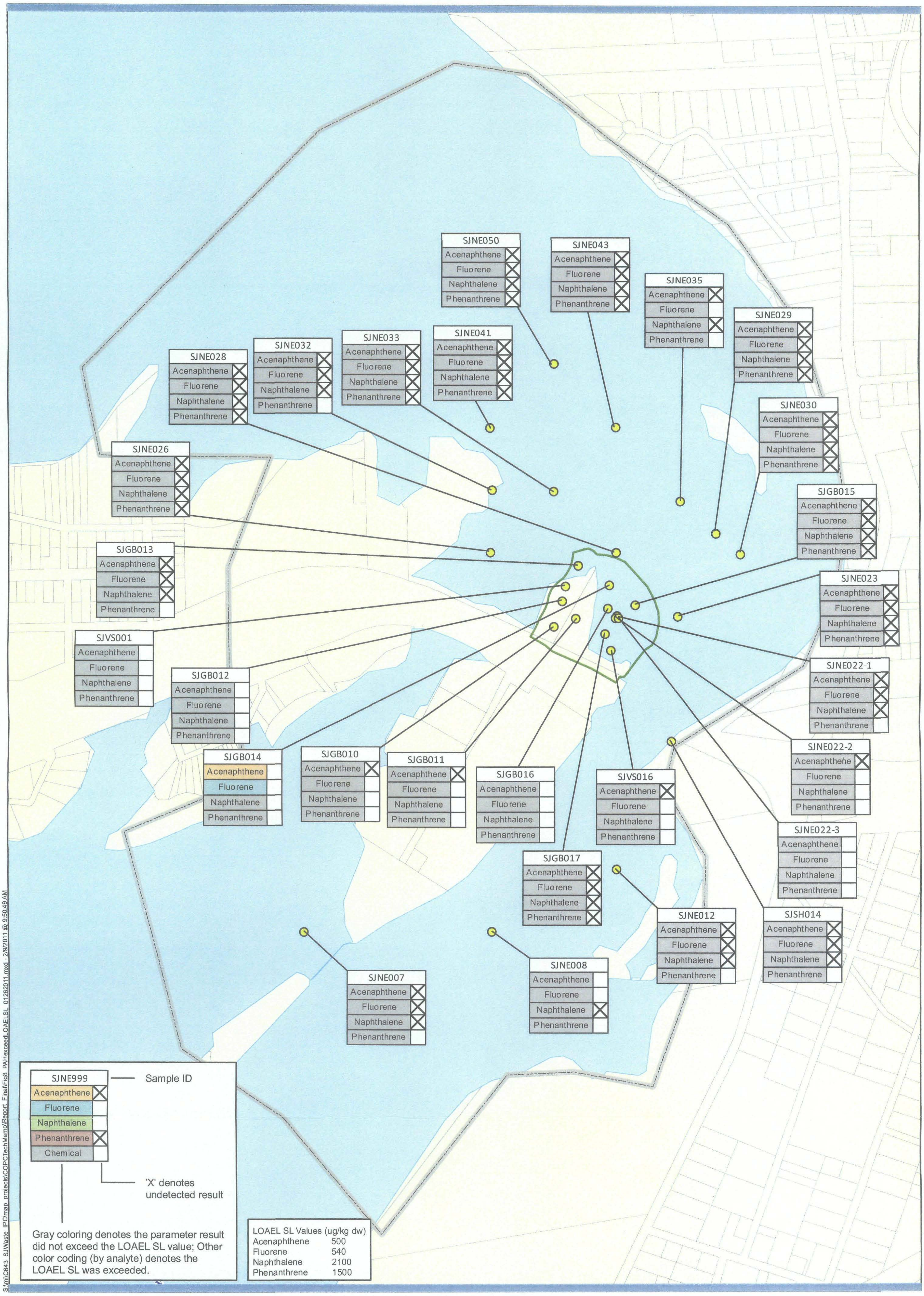
Sample Locations
Original (1966) Perimeter of the Northern Impoundments
Preliminary Site Perimeter
Parcel Boundary

0 1,000
Feet

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District
Hydrology: Harris County Flood Control District

DRAFT

Figure 7
Summary of Data for PAH Compounds in Surface Sediment Relative to Ecological SL Values (NOAELs)
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC



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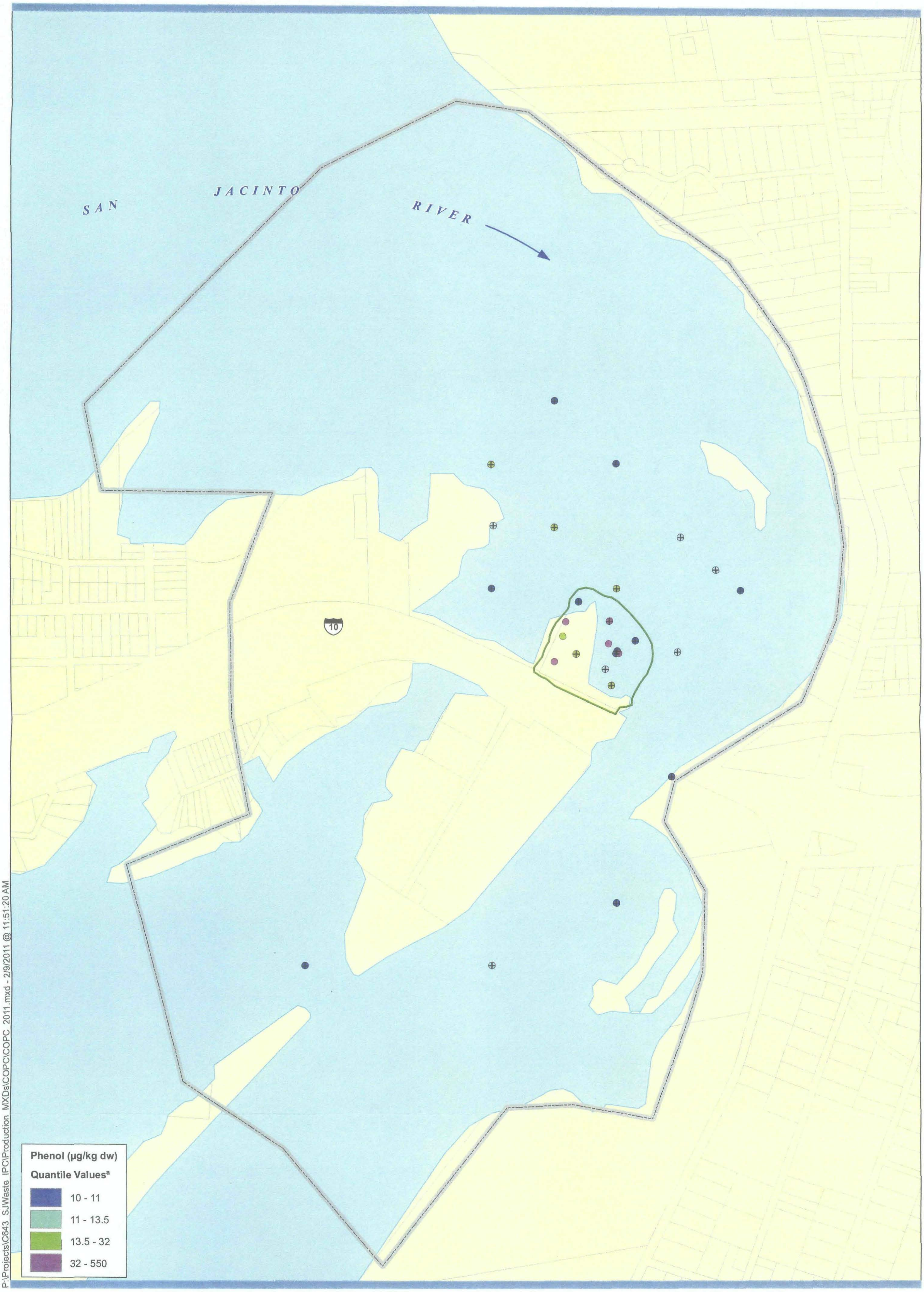
Sample Locations
Original (1966) Perimeter of the Northern Impoundments
Preliminary Site Perimeter
Parcel Boundary

0 1,000
Feet

FEATURE SOURCES:
Parcel Boundaries: Harris County Appraisal District
Hydrology: Harris County Flood Control District

DRAFT

Figure 8
Summary of Data for PAH Compounds in Surface Sediment Relative to Benthic Community LOAELs
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC



ANCHOR QEA integral consulting inc.

0 800
Scale in Feet

DRAFT

[a]No Ecological or Human Health Screening Level

Preliminary Site Perimeter
Original (1966) Perimeter of the Northern Impoundments
Parcel Boundary
RI Sediment Station
RI Sediment Station (Non-Detect)

Figure 9
Phenol in Surface Sediments
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC

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ANCHOR QEA integral consulting inc.

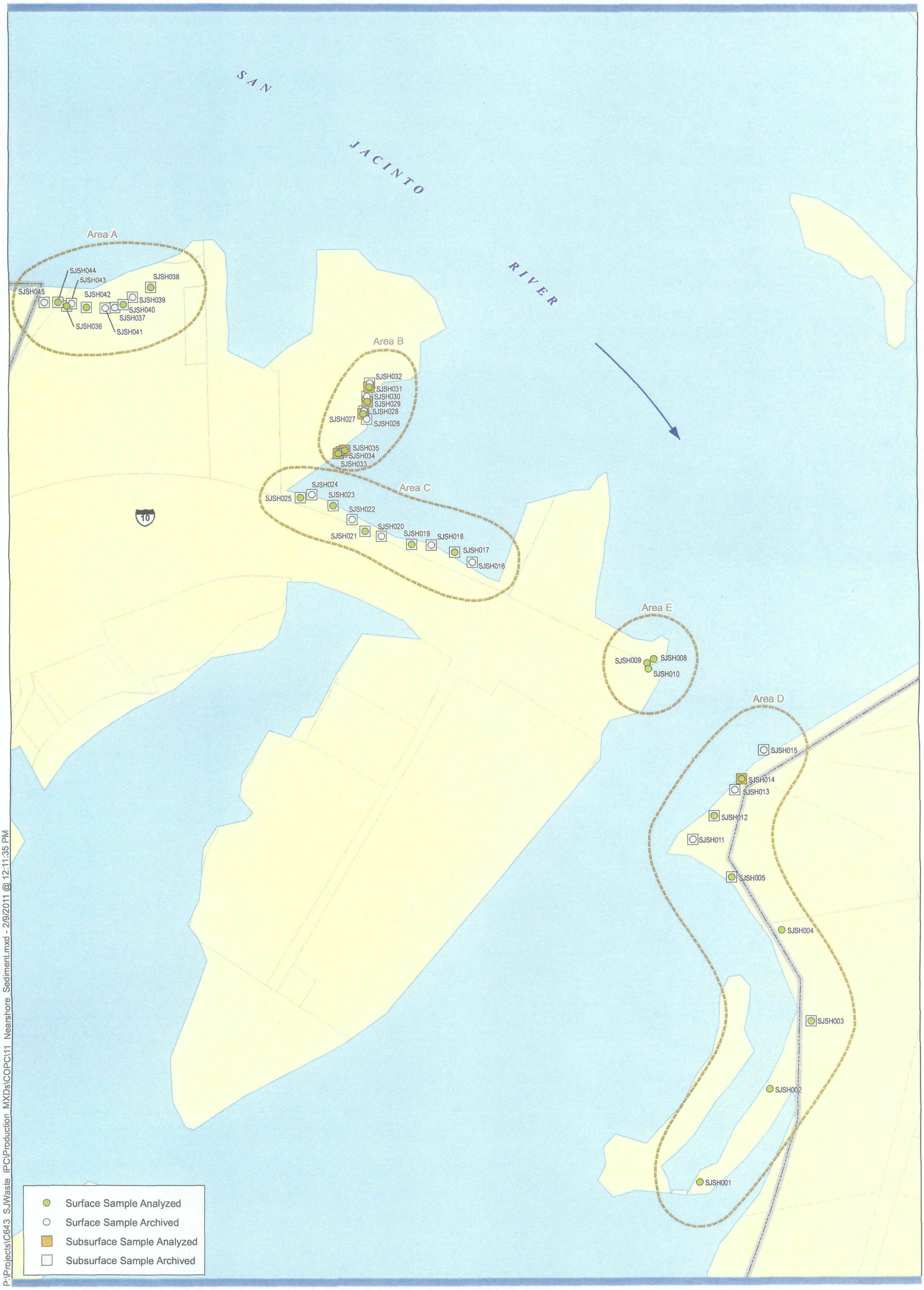
0 800
Scale in Feet

[a]No Ecological or Human Health Screening Level

Preliminary Site Perimeter
Original (1966) Perimeter of the Northern Impoundments
Parcel Boundary
RI Sediment Station
RI Sediment Station (Non-Detect)

DRAFT

Figure 10
Carbazole in Surface Sediments
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC



ANCHOR QEA

integral consulting inc.

Preliminary Site Perimeter
Parcel Boundary
Area Designation

0 500
Scale in Feet

DRAFT

Figure 11
Nearshore Sediment Samples
Collected for Human Exposure Evaluation
COPC Technical Memorandum
SJRWP Superfund/MIMC and IPC

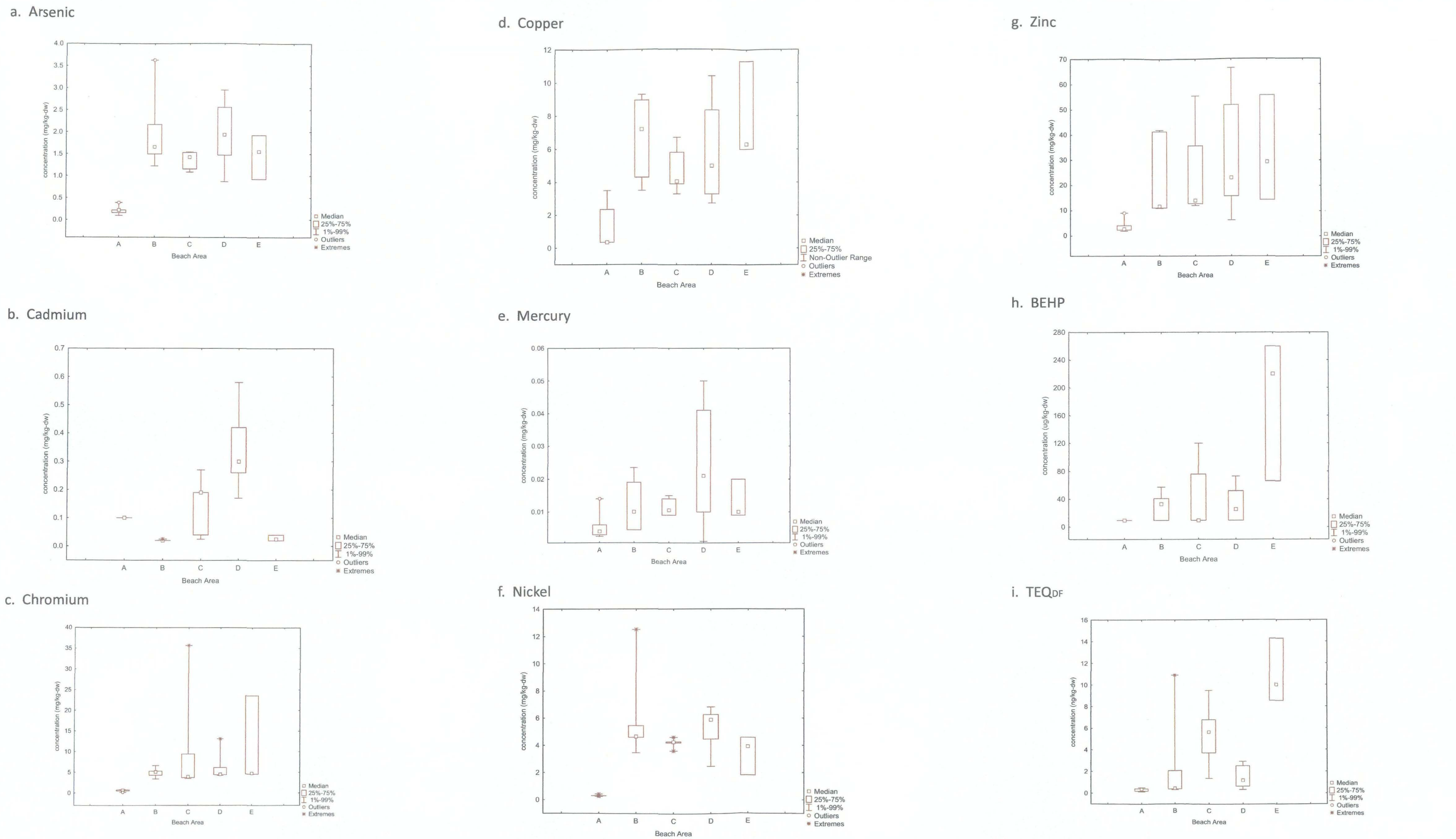


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Figure 12
COPCs in Nearshore Sediment Samples by Beach Area
COPC Technical Memorandum
San Jacinto River Waste Pits Superfund Site

APPENDIX A
QUALITY ASSURANCE REVIEW

1 INTRODUCTION

Thirty six sediment samples were collected in August of 2005 for a high-resolution sampling event associated with the Houston Ship Channel Dioxin Total Maximum Daily Load (TMDL) study (University of Houston and Parsons 2006). Historical sediment chemistry data used in the remedial investigation and feasibility study (RI/FS) must undergo a quality assurance (QA) review to ensure that the data are appropriate for use. This process is described in Section 3.1 of the RI/FS Work Plan, and classifies the data into two categories – Category 1, data of known quality that is appropriate for use in decision making, and Category 2, data of unknown or suspect quality. Sediment data for dioxins and furans from the TMDL study were initially classified as Category 2 data because supporting QA data were not available. Thirty-four QA evaluations of the 2005 high-resolution sediment samples were obtained and this appendix documents a review of those QA evaluations to reclassify this data as Category 1. The samples reviewed are listed in Table A-1

2 EVALUATION

Data is classified as into categories by evaluating the following factors:

- Traceability
- Comparability
- Sample integrity
- Potential measurement bias (i.e., accuracy, precision)

For data to be classified as Category 1 all of these factors must be known or supported by existing QA/QC information including: analytical methods, chain-of-custody, sample holding time, method blanks, matrix spike/matrix spike duplicates, laboratory control samples, replicates, and surrogates. The evaluation of these factors was documented in Appendix D-1 of the Work Plan.

Data verification summary reports prepared by Parsons of Denver, Colorado were obtained from Dr. Hanadi Rifai of the University of Houston in order to re-evaluate the data for the 2005 TMDL sediments (see Attachment 1). The sections below discuss the QA/QC information documented in these reports. The data verification summary reports discuss additional samples not included in Table A-1. Therefore, some QA exceptions are discussed in the reports that do not apply to the samples in Table A-1.

2.1 Analytical Method

All samples were analyzed by Pace Analytical Services, Inc. of Minneapolis, MN by the analytical method specified in the Quality Assurance Project Plan (QAPP) for the TMDL study, EPA method 1613B (modified).

2.2 Chain of Custody

All chain of custody procedures followed those described in the QAPP for the TMDL study.

2.3 Holding Times

The method specified analytical holding time of one year from sample collection to sample extraction was met for all samples listed in Table 1.

2.4 Method Blanks

The method blank criteria set forth in the QAPP for the TMDL study was met, no analytes were reported above the reporting limit. Some results in sample Site 26 were qualified as "B" because the sample results were less than 20 times the concentration found in the associated method blank.

2.5 Matrix Spikes/Matrix Spike Duplicates

Recoveries in the matrix spike/matrix spike duplicates (MS/MSD) met the control limits specified in the QAPP, with the exception of analytes in parent samples having a high analyte concentration. No results were qualified based on MS/MSD recoveries.

2.6 Laboratory Control Samples

Recoveries in the laboratory control samples (LCS) were generally within laboratory control limits. One of the seven LCSs analyzed had recoveries for 1,2,3,6,7,8-HxCDD, 1,2,3,4,7,8,9-HpCDF, and OCDF greater than the QAPP control limit of 125%. No results were qualified on this basis.

2.7 Replicates

Precision was assessed from the relative percent differences (RPD) of both MS/MSDs and laboratory duplicates. MS/MSD RPD values were within the QAPP control limit for laboratory duplicates of 25%, with the exception of analytes present in the parent samples at a high concentration. No sample results were required to be qualified based on MS/MSD RPD results.

Several laboratory duplicate RPD values were greater than the QAPP control limit of and eight results were estimated (J/UJ) on this basis.

2.8 Surrogates

The recoveries of all labeled compounds met the criteria specified in the analytical method, EPA method 1613B.

2.9 Other Findings

The laboratory correctly flagged results below the reporting limits with a "J" to indicate the results are estimated values.

In cases where interferences were observed the laboratory correctly reported the result as an estimated maximum possible concentration (EMPC).

All initial and continuing calibration criteria specified in EPA method 1613B were met with the exception of one continuing calibration verification. No data were qualified on the basis of the calibration results.

3 CONCLUSION

Based on the above review the dioxin and furan data for the samples listed in Table A-1 are of known quality and can be considered to be Category 1 data.

4 REFERENCES

Parsons. Data Verification Summary Report for Dioxins/Furans Samples Collected From Houston Ship Channel Houston, Texas. SDG 05-1018741.

Parsons. Data Verification Summary Report for Dioxins/Furans Samples Collected From Houston Ship Channel Houston, Texas. SDG 05-1019347.

University of Houston and Parsons. 2006. Total Maximum Daily Loads for Dioxins in the Houston Ship Channel. Contract No. 582-6-70860, Work Order No. 582-6-70860-02. Quarterly report No. 3. Prepared in cooperation with the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency. University of Houston and Parsons Water & Infrastructure. Available at: http://www.tceq.state.tx.us/assets/public/implementation/water/tmdl/26hscdioxin/26-all-data-compiled-q3-fy06.pdf.

Table A-1
2005 High-Resolution Sediment Samples

Field Sample ID	Collection Date	Pace SDG	Pace Sample ID
SITE 7	08/15/2005	05-1018741	1018741001
SITE 6	08/15/2005	05-1018741	1018741002
11267	08/16/2005	05-1018741	1018741003
15979	08/16/2005	05-1018741	1018741004
18392	08/16/2005	05-1018741	1018741005
18392-DUP	08/16/2005	05-1018741	1018741006
Site 22	08/16/2005	05-1018741	1018741007
SITE 24	08/16/2005	05-1018741	1018741009
SITE 23	08/16/2005	05-1018741	1018741010
SITE 25	08/16/2005	05-1018741	1018741011
11280	08/16/2005	05-1018741	1018741012
SITE 26	08/17/2005	05-1018741	1018741013
SITE 27	08/17/2005	05-1018741	1018741014
SITE 13	08/17/2005	05-1018741	1018741015
SITE 17	08/17/2005	05-1018741	1018741016
SITE 21	08/17/2005	05-1018741	1018741017
SITE 5	08/17/2005	05-1018741	1018741018
SITE 4	08/17/2005	05-1018741	1018741019
DUP 4	08/18/2005	05-1018741	1018741032
SITE 18	08/17/2005	05-1018741	1018741020
SITE 19	08/17/2005	05-1018741	1018741021
SITE 1	08/17/2005	05-1018741	1018741022
SITE 2	08/17/2005	05-1018741	1018741023
SITE 16	08/18/2005	05-1018741	1018741024
SITE 8	08/18/2005	05-1018741	1018741025
SITE 9	08/18/2005	05-1018741	1018741026
SITE 20	08/18/2005	05-1018741	1018741027
SITE 3	08/18/2005	05-1018741	1018741028
SITE 15	08/18/2005	05-1018741	1018741029
SITE 14	08/18/2005	05-1018741	1018741031
11268	08/16/2005	05-1018741	1018741033
SITE 11	08/18/2005	05-1018741	1018741037
SITE 10	08/30/05	05-1019347	1019347001
SITE 12	08/30/05	05-1019347	1019347002

ATTACHMENT A1

DATA VERIFICATION SUMMARY REPORTS

– 05-1018741

– 05-1019347

DATA VERIFICATION SUMMARY REPORT

FOR

DIOXINS/FURANS SAMPLES

collected from

HOUSTON SHIP CHANNEL

HOUSTON, TEXAS

Data Verifier: Richard Cheatham (Parsons – Denver, CO)

INTRODUCTION

The following data verification summary report covers environmental sediment samples collected from the Houston Ship Channel in Houston, Texas on August 4 and 30, 2004, December 10, 2004, February 17, 2005, and August 15-18, 2005. The samples were received by Pace Analytical Services, Inc., Minneapolis, MN on August 26, 2005 and analyzed for Dioxins/Furans using Method EPA 1613B (modified). Analysis results for forty (40) sediment samples, two (2) equipment blanks, and two trip blanks were reported in the following laboratory Sample Delivery Group (SDG): 05-1018741. Sample identification numbers and sample collection dates are summarized on Table 1. Recommended data qualifiers are summarized on Table 2.

All samples were collected by Parsons following the procedures described in the QAPP. All analyses were performed by Pace Analytical in Minneapolis, Minnesota following procedures outlined in the QAPP.

EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the QAPP and National Functional Guidelines for Organic and Inorganic Data (EPA 1994). Information reviewed in the data packages include sample results; the laboratory quality control results; instrument calibrations; blanks; case narrative and chain-of-custody forms. The validation protocol addressed the following parameters: method blanks, laboratory control spike recoveries, recoveries of labeled compounds (internal standards), instrument calibrations, continuing calibration verifications, MS/MSD results, field duplicate sample results, and AWRL check standard results. The analyses and findings presented in this report are based on the reviewed information, and meeting guidelines in the QAPP (with the exceptions noted below).

DIOXINS AND FURANS

General

The SDG included in this report, 05-1018741, consisted of forty (40) soil samples analyzed for Dioxins/Furans (PCDD/PCDF) using USEPA Method 1613B (modified). All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method, except where noted.

Accuracy

Accuracy was evaluated using the %R results for the laboratory control sample (LCS), matrix spike/matrix spike duplicates (MS/MSDs), and labeled compound spikes.

- The LCS results met criteria (laboratory control limits). Six LCS samples were analyzed with this SDG.
- Samples Site 7, Site 24, Site 5, and Dup-4 were utilized for MS/MSD analyses. MS/MSD recoveries were within acceptance limits (QAPP Table A-2), with the exception of analytes in parent samples having a high analyte concentration, which rendered the spike recovery results to be not meaningful. No sample results were qualified based on MS/MSD recoveries.
- Labeled compound spike (internal standard) recoveries met advisory criteria (Method 1613B. The 2,3,7,8-substituted congeners are quantified based on isotope dilution. Therefore, the sample results were not qualified.
- In those instances where a PCDF compound and "interference" or an interfering PCDE compound were both identified, denoted by the laboratory flag of "E" for PCDE interference and "I" for interference, the laboratory correctly reported the sample results as "estimated maximum possible concentration" (EMPC) values, rather than as a "concentration" value.
- Sample results reported by laboratory with a "J" data flag, denoting that reported sample result is greater than the MDL but less than the laboratory's reporting limit (RL) are considered to be estimated values. Qualified values are summarized on Table 2.

Precision

Analytical precision was evaluated using the Relative Percent Difference (RPD) values obtained from matrix spiked samples (MS/MSD), and from laboratory duplicate sample analyses. Evaluation results are as follows:

- Samples Site 7, Site 24, Site 5, and Dup-4 were utilized for MS/MSD analyses. MS/MSD RPD values were within acceptance limits (QAPP Table A-2), with the exception of analytes in parent samples having a high analyte concentration, which rendered the spike recovery results to be not meaningful. No sample results were required to be qualified based on MS/MSD RPD results.

- Samples Site 6 11267, Site 23, Site 4, and Trip Blank 2 were utilized for laboratory duplicate sample analyses. Laboratory duplicate sample RPD values were within acceptance limits (25% RPD, QAPP Table A-2), with the exceptions shown below.

Sample ID	Analyte	RPD (%)	Affected Samples	Qual.
Site 6	Total PeCDD	40.0	Site 6	J/UJ
Site 6	1,2,3,4,6,7,8-HpCF	38.0	Site 6	J/UJ
Site 6	Total HpCDF	27.2	Site 6	J/UJ
11267	1,2,3,7,8,9-HxCDF	43.9	11267	J/UJ
11267	Total HxCDF	83.3	11267	J/UJ
Site 23	Total HxCDF	31.6	Site 23	J/UJ
Site 23	Total HxCDD	47.3	Site 23	J/UJ
Site 4	1,2,3,4,6,7,8-HPCDF	27.5	Site 4	J/UJ

Overall precision was evaluated from the RPD values calculated from the sample analysis results of the parent sample/field duplicate sample pair. Samples 18392 (18392/18392-DUP), Site 2 (Site 2/Dup 2), Site 3 (Site 3/Dup 3), and Site 4 (Dup 4) were collected in duplicate.

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the chain-of-custody procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining method blanks for contamination of samples during analysis.

The samples in all SDGs were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

- Analytical holding time of 1-yr. until sample extraction from sample collection was met, with the exception of samples 11261-81cm, 1193-68cm, and 15244-50&52cm. for which the holding time was exceeded by 24, 10, and 43 days, respectively.
- All method blank criteria were met. In the method blank associated with this SDG, no analytes were reported at levels above the AWRL. Analytes were detected in the method blanks at concentrations less than the rep the reporting limit as shown below. Associated sample concentrations less than 20x method blank concentration were qualified as "B" for method blank contamination. The

result for 1,2,3,6,7,8 (1.70 ng/kg) in sample Site 25 was qualified as "B" based on associated method blank contamination.

- All initial calibration criteria were met.
- All continuing calibration criteria were met, with the exception of a marginal exceedance of the %D (27.6%) for 1,2,3,4,6,7,8-HpCDD-13C in the CCV from 09/10/2005. No sample results were required to be qualified based on CCV results.
- All AWRL standard criteria were met. AWRL calculation checks are presented on Table 3.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated (qualified "R"). The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

TABLE 1 – VALIDATED SAMPLES AND ANALYTICAL PARAMETERS

Field Sample ID	Sample Type	Collection Date	Sample Matrix	Pace SDG	Pace Sample ID	Pace Sample Receipt Date	Sample Prep (Extraction) Date	PCDD/ PCDF Analysis Date
SITE 7	Comp	08/15/2005	Sed	05-1018741	1018741001	08/26/2005	08/31/2005	09/04/2005
SITE 6	Comp	08/15/2005	Sed	05-1018741	1018741002	08/26/2005	08/31/2005	09/04/2005
11267	Comp	08/16/2005	Sed	05-1018741	1018741003	08/26/2005	08/31/2005	09/04/2005
15979	Comp	08/16/2005	Sed	05-1018741	1018741004	08/26/2005	08/31/2005	09/04/2005
18392	Comp	08/16/2005	Sed	05-1018741	1018741005	08/26/2005	08/31/2005	09/05/2005
18392-DUP	Comp	08/16/2005	Sed	05-1018741	1018741006	08/26/2005	08/31/2005	09/05/2005
Site 22	Comp	08/16/2005	Sed	05-1018741	1018741007	08/26/2005	08/31/2005	09/05/2005
Equip. blank	Comp	08/16/2005	Sed	05-1018741	1018741008	08/26/2005	09/02/2005	09/12/2005
SITE 24	Comp	08/16/2005	Sed	05-1018741	1018741009	08/26/2005	09/02/2005	09/12/2005
SITE 23	Comp	08/16/2005	Sed	05-1018741	1018741010	08/26/2005	09/02/2005	09/12/2005
SITE 25	Comp	08/16/2005	Sed	05-1018741	1018741011	08/26/2005	09/02/2005	09/12/2005
11280	Comp	08/16/2005	Sed	05-1018741	1018741012	08/26/2005	09/02/2005	09/12/2005
SITE 26	Comp	08/17/2005	Sed	05-1018741	1018741013	08/26/2005	09/13/2005	09/16/2005
SITE 27	Comp	08/17/2005	Sed	05-1018741	1018741014	08/26/2005	09/02/2005	09/12/2005
SITE 13	Comp	08/17/2005	Sed	05-1018741	1018741015	08/26/2005	09/02/2005	09/12/2005
SITE 17	Comp	08/17/2005	Sed	05-1018741	1018741016	08/26/2005	09/02/2005	09/12/2005
SITE 21	Comp	08/17/2005	Sed	05-1018741	1018741017	08/26/2005	09/02/2005	09/12/2005
SITE 5	Comp	08/17/2005	Sed	05-1018741	1018741018	08/26/2005	09/07/2005	09/10/2005
SITE 4	Comp	08/17/2005	Sed	05-1018741	1018741019	08/26/2005	09/07/2005	09/10/2005
SITE 18	Comp	08/17/2005	Sed	05-1018741	1018741020	08/26/2005	09/07/2005	09/10/2005
SITE 19	Comp	08/17/2005	Sed	05-1018741	1018741021	08/26/2005	09/07/2005	09/12/2005
SITE 1	Comp	08/17/2005	Sed	05-1018741	1018741022	08/26/2005	09/07/2005	09/10/2005
SITE 2	Comp	08/17/2005	Sed	05-1018741	1018741023	08/26/2005	09/07/2005	09/12/2005
SITE 16	Comp	08/18/2005	Sed	05-1018741	1018741024	08/26/2005	09/07/2005	09/11/2005
SITE 8	Comp	08/18/2005	Sed	05-1018741	1018741025	08/26/2005	09/07/2005	09/11/2005
SITE 9	Comp	08/18/2005	Sed	05-1018741	1018741026	08/26/2005	09/09/2005	09/14/2005
SITE 20	Comp	08/18/2005	Sed	05-1018741	1018741027	08/26/2005	09/07/2005	09/11/2005
SITE 3	Comp	08/18/2005	Sed	05-1018741	1018741028	08/26/2005	09/07/2005	09/12/2005
SITE 15	Comp	08/18/2005	Sed	05-1018741	1018741029	08/26/2005	09/07/2005	09/13/2005
DUP 3	Comp	08/18/2005	Sed	05-1018741	1018741030	08/26/2005	09/07/2005	09/13/2005
SITE 14	Comp	08/18/2005	Sed	05-1018741	1018741031	08/26/2005	09/07/2005	09/13/2005
DUP 4	Comp	08/18/2005	Sed	05-1018741	1018741032	08/26/2005	09/09/2005	09/15/2005
11268	Comp	08/16/2005	Sed	05-1018741	1018741033	08/26/2005	09/09/2005	09/17/2005
Equipment Blank 2	Comp	08/18/2005	Sed	05-1018741	1018741034	08/26/2005	09/09/2005	09/16/2005
Trip Blank 1	Comp	08/18/2005	Sed	05-1018741	1018741035	08/26/2005	09/09/2005	09/15/2005
Trip Blank 2	Comp	08/18/2005	Sed	05-1018741	1018741036	08/26/2005	09/09/2005	09/15/2005
SITE 11	Comp	08/18/2005	Sed	05-1018741	1018741037	08/26/2005	09/09/2005	09/15/2005
DUP-2	Comp	08/17/2005	Sed	05-1018741	1018741038	08/26/2005	09/09/2005	09/16/2005
11261-81CM	Comp	08/16/2004	Sed	05-1018741	1018741039	08/26/2005	**09/09/2005**	09/16/2005
13337-66CM	Comp	02/17/2005	Sed	05-1018741	1018741040	08/26/2005	09/09/2005	09/16/2005
16499-80CM	Comp	02/17/2005	Sed	05-1018741	1018741041	08/26/2005	09/09/2005	09/16/2005
11193-68CM	Comp	08/30/2004	Sed	05-1018741	1018741042	08/26/2005	**09/09/2005**	09/15/2005
FW1A	Comp	12/10/2004	Sed	05-1018741	1018741043	08/26/2005	09/09/2005	09/15/2005
15244-50&52cm	Comp	08/04/2004	Sed	05-1018741	1018741044	08/26/2005	**09/26/2005**	10/02/2005

TABLE 2 - SUMMARY OF QUALIFIED DATA

Sample ID	Lab Sample ID	Analyte	Result	Units	Lab Flag	Data Qualifier	Reason
11261-81cm	1018741039	ALL PCDD and ALL PCDF Analytes		ng/kg		J/UJ	Holding Time (Sample Extraction)
11193-68cm	1018741042	ALL PCDD and ALL PCDF Analytes		ng/kg		J/UJ	Holding Time (Sample Extraction)
15244-50&52cm	1018741044	ALL PCDD and ALL PCDF Analytes		ng/kg		J/UJ	Holding Time (Sample Extraction)
Site 6	1018741002	Total PeCDD	1.60	ng/kg			Lab Dup RPD
Site 6	1018741002	1,2,3,4,6,7,8-HpCF	4.70	ng/kg			Lab Dup RPD
Site 6	1018741002	Total HpCDF	9.60	ng/kg			Lab Dup RPD
11267	1018741003	1,2,3,7,8,9-HxCDF	16.0	ng/kg			Lab Dup RPD
11267	1018741003	Total HxCDF	140.0	ng/kg			Lab Dup RPD
Site 23	1018741010	Total HxCDF	55.0	ng/kg			Lab Dup RPD
Site 23	1018741010	Total HxCDD	81.0	ng/kg			Lab Dup RPD
Site 4	1018741019	1,2,3,4,6,7,8-HpCDF	4.70	ng/kg			Lab Dup RPD
Site 26	1018741013	1,2,3,6,7,8-HxCDF	1.70	ng/kg	BJA	B	Method blank
SITE 7	1018741001	1,2,3,7,8-PeCDF	0.95	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	2,3,4,7,8-PeCDF	0.92	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	1,2,3,7,8-PeCDD	0.38	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	Total PeCDD	3.30	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	1,2,3,4,7,8-HxCDF	1.80	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	2,3,4,6,7,8-HxCDF	0.41	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	1,2,3,4,7,8-HxCDD	0.54	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	1,2,3,6,7,8-HxCDD	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	1,2,3,7,8,9-HxCDD	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 7	1018741001	1,2,3,4,7,8,9-HpCDF	0.65	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	1,2,3,7,8-PeCDF	0.83	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	2,3,4,7,8-PeCDF	0.80	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	Total PeCDF	3.40	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	Total PeCDD	1.60	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	1,2,3,4,7,8-HxCDF	1.30	ng/kg	J	J	Sample result <reporting limit

SITE 6	1018741002	1,2,3,6,7,8-HxCDF	0.64	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	1,2,3,4,7,8-HxCDD	0.90	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	1,2,3,7,8,9-HxCDD	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 6	1018741002	1,2,3,4,7,8,9-HpCDF	0.60	ng/kg	J	J	Sample result <reporting limit
11267	1018741003	1,2,3,7,8-PeCDD	1.6	ng/kg	J	J	Sample result <reporting limit
11267	1018741003	1,2,3,4,7,8-HxCDD	2.7	ng/kg	J	J	Sample result <reporting limit
11267	1018741003	1,2,3,7,8,9-HxCDD	4.1	ng/kg	J	J	Sample result <reporting limit
15979	1018741004	1,2,3,7,8-PeCDF	3.5	ng/kg	J	J	Sample result <reporting limit
15979	1018741004	2,3,4,7,8-PeCDF	3.5	ng/kg	J	J	Sample result <reporting limit
15979	1018741004	1,2,3,7,8-PeCDD	1.5	ng/kg	J	J	Sample result <reporting limit
15979	1018741004	1,2,3,6,7,8-HxCDF	3.6	ng/kg	J	J	Sample result <reporting limit
15979	1018741004	2,3,4,6,7,8-HxCDF	2.5	ng/kg	J	J	Sample result <reporting limit
15979	1018741004	1,2,3,7,8,9-HxCDF	2.6	ng/kg	J	J	Sample result <reporting limit
15979	1018741004	1,2,3,7,8,9-HxCDD	4.8	ng/kg	J	J	Sample result <reporting limit
18392	1018741005	1,2,3,7,8-PeCDF	2.8	ng/kg	J	J	Sample result <reporting limit
18392	1018741005	2,3,4,7,8-PeCDF	3.5	ng/kg	J	J	Sample result <reporting limit
18392	1018741005	1,2,3,6,7,8-HxCDF	1.8	ng/kg	J	J	Sample result <reporting limit
18392	1018741005	1,2,3,7,8,9-HxCDF	1.5	ng/kg	J	J	Sample result <reporting limit
18392	1018741005	1,2,3,6,7,8-HxCDD	4.0	ng/kg	J	J	Sample result <reporting limit
18392	1018741005	1,2,3,4,7,8,9-HpCDF	2.7	ng/kg	J	J	Sample result <reporting limit
18392-DUP	1018741006	1,2,3,7,8-PeCDF	1.9	ng/kg	J	J	Sample result <reporting limit
18392-DUP	1018741006	2,3,4,7,8-PeCDF	2.7	ng/kg	J	J	Sample result <reporting limit
18392-DUP	1018741006	1,2,3,6,7,8-HxCDF	1.5	ng/kg	J	J	Sample result <reporting limit
18392-DUP	1018741006	2,3,4,6,7,8-HxCDF	1.6	ng/kg	J	J	Sample result <reporting limit
18392-DUP	1018741006	1,2,3,7,8,9-HxCDF	1.3	ng/kg	J	J	Sample result <reporting limit
18392-DUP	1018741006	1,2,3,4,7,8-HxCDD	2.1	ng/kg	J	J	Sample result <reporting limit

18392-DUP	1018741006	1,2,3,6,7,8-HxCDD	3.5	ng/kg	J	J	Sample result <reporting limit
18392-DUP	1018741006	1,2,3,7,8,9-HxCDD	4.3	ng/kg	J	J	Sample result <reporting limit
SITE 22	1018741007	2,3,4,7,8-PeCDF	4.9	ng/kg	J	J	Sample result <reporting limit
SITE 22	1018741007	1,2,3,7,8-PeCDD	1.0	ng/kg	J	J	Sample result <reporting limit
SITE 22	1018741007	1,2,3,6,7,8-HxCDF	2.3	ng/kg	J	J	Sample result <reporting limit
SITE 22	1018741007	2,3,4,6,7,8-HxCDF	1.4	ng/kg	J	J	Sample result <reporting limit
SITE 22	1018741007	1,2,3,7,8,9-HxCDF	1.6	ng/kg	J	J	Sample result <reporting limit
SITE 22	1018741007	1,2,3,4,7,8-HxCDD	3.7	ng/kg	J	J	Sample result <reporting limit
SITE 22	1018741007	1,2,3,4,7,8,9-HpCDF	2.7	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	1,2,3,7,8-PeCDF	6.4	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	2,3,4,7,8-PeCDF	6.1	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	1,2,3,7,8-PeCDD	1.9	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	1,2,3,6,7,8-HxCDF	3.5	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	2,3,4,6,7,8-HxCDF	1.8	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	1,2,3,7,8,9-HxCDF	1.9	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	1,2,3,4,7,8-HxCDD	2.7	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	1,2,3,7,8,9-HxCDD	5.7	ng/kg	J	J	Sample result <reporting limit
SITE 24	1018741009	1,2,3,4,7,8,9-HpCDF	4.3	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	1,2,3,7,8-PeCDF	2.7	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	1,2,3,7,8-PeCDD	1.4	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	1,2,3,4,7,8-HxCDF	4.6	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	1,2,3,6,7,8-HxCDF	2.5	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	2,3,4,6,7,8-HxCDF	1.6	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	1,2,3,7,8,9-HxCDF	1.1	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	1,2,3,4,7,8-HxCDD	1.8	ng/kg	J	J	Sample result <reporting limit
SITE 23	1018741010	1,2,3,7,8,9-HxCDD	3.8	ng/kg	J	J	Sample result <reporting limit

SITE 23	1018741010	1,2,3,4,7,8,9-HpCDF	2.3	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,7,8-PeCDF	1.90	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	2,3,4,7,8-PeCDF	2.20	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,7,8-PeCDD	0.74	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,4,7,8-HxCDF	4.30	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,6,7,8-HxCDF	1.50	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	2,3,4,6,7,8-HxCDF	1.20	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,7,8,9-HxCDF	0.65	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,4,7,8-HxCDD	1.20	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,6,7,8-HxCDD	2.60	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,7,8,9-HxCDD	2.50	ng/kg	J	J	Sample result <reporting limit
SITE 25	1018741011	1,2,3,4,7,8,9-HpCDF	2.30	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	1,2,3,7,8-PeCDF	3.4	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	2,3,4,7,8-PeCDF	3.1	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	1,2,3,7,8-PeCDD	1.1	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	1,2,3,6,7,8-HxCDF	2.4	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	2,3,4,6,7,8-HxCDF	1.3	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	1,2,3,7,8,9-HxCDF	1.0	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	1,2,3,4,7,8-HxCDD	1.8	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	1,2,3,7,8,9-HxCDD	3.5	ng/kg	J	J	Sample result <reporting limit
11280	1018741012	1,2,3,4,7,8,9-HpCDF	2.3	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,7,8-PeCDF	1.90	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	2,3,4,7,8-PeCDF	2.00	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,7,8-PeCDD	0.84	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,4,7,8-HxCDF	3.60	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,6,7,8-HxCDF	1.70	ng/kg	J	J	Sample result <reporting limit

SITE 26	1018741013	2,3,4,6,7,8-HxCDF	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,7,8,9-HxCDF	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,4,7,8-HxCDD	1.60	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,6,7,8-HxCDD	3.20	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,7,8,9-HxCDD	3.00	ng/kg	J	J	Sample result <reporting limit
SITE 26	1018741013	1,2,3,4,7,8,9-HpCDF	4.70	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,7,8-PeCDF	3.40	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	2,3,4,7,8-PeCDF	3.40	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,7,8-PeCDD	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,4,7,8-HxCDF	5.10	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,6,7,8-HxCDF	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	2,3,4,6,7,8-HxCDF	2.00	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,7,8,9-HxCDF	0.76	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,4,7,8-HxCDD	1.70	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,6,7,8-HxCDD	4.30	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,7,8,9-HxCDD	3.40	ng/kg	J	J	Sample result <reporting limit
SITE 27	1018741014	1,2,3,4,7,8,9-HpCDF	5.40	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,7,8-PeCDF	2.50	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	2,3,4,7,8-PeCDF	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,7,8-PeCDD	0.30	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,4,7,8-HxCDF	2.80	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,6,7,8-HxCDF	0.97	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,7,8,9-HxCDF	0.63	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,4,7,8-HxCDD	0.42	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,6,7,8-HxCDD	0.94	ng/kg	J	J	Sample result <reporting limit
SITE 13	1018741015	1,2,3,7,8,9-HxCDD	1.20	ng/kg	J	J	Sample result <reporting limit

SITE 13	1018741015	1,2,3,4,7,8,9-HpCDF	0.57	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,7,8-PeCDF	2.20	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	2,3,4,7,8-PeCDF	2.00	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,7,8-PeCDD	0.55	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,4,7,8-HxCDF	3.10	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,6,7,8-HxCDF	0.86	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	2,3,4,6,7,8-HxCDF	0.65	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,7,8,9-HxCDF	0.30	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,4,7,8-HxCDD	0.81	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,6,7,8-HxCDD	1.90	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,7,8,9-HxCDD	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 17	1018741016	1,2,3,4,7,8,9-HpCDF	1.20	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,7,8-PeCDF	3.00	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	2,3,4,7,8-PeCDF	2.80	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,7,8-PeCDD	0.97	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,4,7,8-HxCDF	4.00	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,6,7,8-HxCDF	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	2,3,4,6,7,8-HxCDF	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,7,8,9-HxCDF	0.78	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,4,7,8-HxCDD	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,6,7,8-HxCDD	3.30	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,7,8,9-HxCDD	3.80	ng/kg	J	J	Sample result <reporting limit
SITE 21	1018741017	1,2,3,4,7,8,9-HpCDF	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,7,8-PeCDF	0.83	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	2,3,4,7,8-PeCDF	0.86	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,7,8-PeCDD	0.41	ng/kg	J	J	Sample result <reporting limit

SITE 5	1018741018	1,2,3,4,7,8-HxCDF	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,6,7,8-HxCDF	0.43	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	2,3,4,6,7,8-HxCDF	0.42	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,7,8,9-HxCDF	0.26	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,4,7,8-HxCDD	0.81	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,6,7,8-HxCDD	1.50	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,7,8,9-HxCDD	1.60	ng/kg	J	J	Sample result <reporting limit
SITE 5	1018741018	1,2,3,4,7,8,9-HpCDF	0.68	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,7,8-PeCDF	0.98	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	2,3,4,7,8-PeCDF	0.87	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,7,8-PeCDD	0.35	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,4,7,8-HxCDF	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,6,7,8-HxCDF	0.80	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	2,3,4,6,7,8-HxCDF	0.38	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,7,8,9-HxCDF	0.27	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,4,7,8-HxCDD	0.56	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,6,7,8-HxCDD	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,7,8,9-HxCDD	1.70	ng/kg	J	J	Sample result <reporting limit
SITE 4	1018741019	1,2,3,4,7,8,9-HpCDF	0.68	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,7,8-PeCDF	5.10	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	2,3,4,7,8-PeCDF	3.60	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,7,8-PeCDD	0.97	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,4,7,8-HxCDF	4.70	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,6,7,8-HxCDF	2.80	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	2,3,4,6,7,8-HxCDF	1.60	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,7,8,9-HxCDF	2.60	ng/kg	J	J	Sample result <reporting limit

SITE 18	1018741020	1,2,3,4,7,8-HxCDD	1.70	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,6,7,8-HxCDD	3.80	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,7,8,9-HxCDD	4.00	ng/kg	J	J	Sample result <reporting limit
SITE 18	1018741020	1,2,3,4,7,8,9-HpCDF	3.10	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,7,8-PeCDF	1.80	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	2,3,4,7,8-PeCDF	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,7,8-PeCDD	0.38	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,4,7,8-HxCDF	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,6,7,8-HxCDF	0.75	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	2,3,4,6,7,8-HxCDF	0.51	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,7,8,9-HxCDF	0.41	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,4,7,8-HxCDD	0.76	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,6,7,8-HxCDD	1.70	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,7,8,9-HxCDD	1.90	ng/kg	J	J	Sample result <reporting limit
SITE 19	1018741021	1,2,3,4,7,8,9-HpCDF	0.96	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,7,8-PeCDF	5.10	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	2,3,4,7,8-PeCDF	4.50	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,7,8-PeCDD	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,4,7,8-HxCDF	5.10	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,6,7,8-HxCDF	2.40	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	2,3,4,6,7,8-HxCDF	1.20	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,7,8,9-HxCDF	0.93	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,4,7,8-HxCDD	1.20	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,6,7,8-HxCDD	3.00	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,7,8,9-HxCDD	3.20	ng/kg	J	J	Sample result <reporting limit
SITE 1	1018741022	1,2,3,4,7,8,9-HpCDF	1.60	ng/kg	J	J	Sample result <reporting limit

SITE 2	1018741023	1,2,3,7,8-PeCDF	4.80	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	2,3,4,7,8-PeCDF	4.00	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,7,8-PeCDD	0.94	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,4,7,8-HxCDF	5.80	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,6,7,8-HxCDF	2.00	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	2,3,4,6,7,8-HxCDF	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,7,8,9-HxCDF	0.92	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,4,7,8-HxCDD	1.50	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,6,7,8-HxCDD	3.00	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,7,8,9-HxCDD	3.70	ng/kg	J	J	Sample result <reporting limit
SITE 2	1018741023	1,2,3,4,7,8,9-HpCDF	1.70	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	1,2,3,7,8-PeCDD	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	1,2,3,6,7,8-HxCDF	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	2,3,4,6,7,8-HxCDF	0.66	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	1,2,3,7,8,9-HxCDF	0.91	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	1,2,3,6,7,8-HxCDD	0.79	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	1,2,3,7,8,9-HxCDD	0.86	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	1,2,3,4,6,7,8-HpCDF	2.90	ng/kg	J	J	Sample result <reporting limit
SITE 16	1018741024	1,2,3,4,7,8,9-HpCDF	0.95	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,7,8-PeCDF	2.10	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	2,3,4,7,8-PeCDF	1.90	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,7,8-PeCDD	0.59	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,4,7,8-HxCDF	3.00	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,6,7,8-HxCDF	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	2,3,4,6,7,8-HxCDF	0.61	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,7,8,9-HxCDF	0.56	ng/kg	J	J	Sample result <reporting limit

SITE 8	1018741025	1,2,3,4,7,8-HxCDD	0.78	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,6,7,8-HxCDD	1.90	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,7,8,9-HxCDD	2.20	ng/kg	J	J	Sample result <reporting limit
SITE 8	1018741025	1,2,3,4,7,8,9-HpCDF	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,7,8-PeCDF	0.99	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	2,3,4,7,8-PeCDF	0.84	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	Total PeCDF	3.00	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,7,8-PeCDD	0.49	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	Total PeCDD	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,6,7,8-HxCDF	1.40	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	2,3,4,6,7,8-HxCDF	0.38	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,7,8,9-HxCDF	0.30	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,4,7,8-HxCDD	0.76	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,6,7,8-HxCDD	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,7,8,9-HxCDD	1.80	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,4,6,7,8-HpCDF	4.30	ng/kg	J	J	Sample result <reporting limit
SITE 9	1018741026	1,2,3,4,7,8,9-HpCDF	0.54	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	1,2,3,7,8-PeCDF	0.20	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	2,3,4,7,8-PeCDF	0.14	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	Total PeCDF	0.70	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	Total PeCDD	0.89	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	1,2,3,4,7,8-HxCDF	0.25	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	1,2,3,6,7,8-HxCDF	0.12	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	2,3,4,6,7,8-HxCDF	0.13	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	Total HxCDF	0.95	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	1,2,3,4,7,8-HxCDD	0.15	ng/kg	J	J	Sample result <reporting limit

SITE 20	1018741027	1,2,3,6,7,8-HxCDD	0.28	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	1,2,3,7,8,9-HxCDD	0.33	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	1,2,3,4,6,7,8-HpCDF	0.85	ng/kg	J	J	Sample result <reporting limit
SITE 20	1018741027	Total HpCDF	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,7,8-PeCDF	2.00	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	2,3,4,7,8-PeCDF	1.80	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,7,8-PeCDD	0.59	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,4,7,8-HxCDF	2.70	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,6,7,8-HxCDF	0.92	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	2,3,4,6,7,8-HxCDF	0.69	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,7,8,9-HxCDF	0.27	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,4,7,8-HxCDD	1.00	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,6,7,8-HxCDD	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,7,8,9-HxCDD	2.70	ng/kg	J	J	Sample result <reporting limit
SITE 3	1018741028	1,2,3,4,7,8,9-HpCDF	1.30	ng/kg	J	J	Sample result <reporting limit
SITE 15	1018741029	1,2,3,4,7,8-HxCDD	3.5	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,7,8-PeCDF	2.50	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	2,3,4,7,8-PeCDF	2.00	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,7,8-PeCDD	0.34	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	Total PeCDD	1.80	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,4,7,8-HxCDF	3.40	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,6,7,8-HxCDF	0.92	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	2,3,4,6,7,8-HxCDF	0.27	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,7,8,9-HxCDF	0.33	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,4,7,8-HxCDD	0.19	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,7,8,9-HxCDD	0.43	ng/kg	J	J	Sample result <reporting limit

SITE 14	1018741031	1,2,3,4,6,7,8-HpCDF	2.00	ng/kg	J	J	Sample result <reporting limit
SITE 14	1018741031	1,2,3,4,7,8,9-HpCDF	0.55	ng/kg	J	J	Sample result <reporting limit
DUP 4	1018741032	1,2,3,7,8-PeCDD	3.9	ng/kg	J	J	Sample result <reporting limit
DUP 4	1018741032	2,3,4,6,7,8-HxCDF	2.5	ng/kg	J	J	Sample result <reporting limit
DUP 4	1018741032	1,2,3,7,8,9-HxCDF	4.3	ng/kg	J	J	Sample result <reporting limit
DUP 4	1018741032	1,2,3,4,7,8-HxCDD	1.1	ng/kg	J	J	Sample result <reporting limit
DUP 4	1018741032	1,2,3,6,7,8-HxCDD	2.7	ng/kg	J	J	Sample result <reporting limit
DUP 4	1018741032	1,2,3,7,8,9-HxCDD	2.6	ng/kg	J	J	Sample result <reporting limit
DUP 4	1018741032	1,2,3,4,7,8,9-HpCDF	4.3	ng/kg	J	J	Sample result <reporting limit
11268	1018741033	2,3,4,7,8-PeCDF	4.7	ng/kg	J	J	Sample result <reporting limit
11268	1018741033	1,2,3,7,8-PeCDD	1.7	ng/kg	J	J	Sample result <reporting limit
11268	1018741033	1,2,3,6,7,8-HxCDF	3.1	ng/kg	J	J	Sample result <reporting limit
11268	1018741033	2,3,4,6,7,8-HxCDF	2.7	ng/kg	J	J	Sample result <reporting limit
11268	1018741033	1,2,3,7,8,9-HxCDF	3.3	ng/kg	J	J	Sample result <reporting limit
11268	1018741033	1,2,3,4,7,8-HxCDD	2.4	ng/kg	J	J	Sample result <reporting limit
SITE 11	1018741037	1,2,3,7,8-PeCDD	3.7	ng/kg	J	J	Sample result <reporting limit
SITE 11	1018741037	2,3,4,6,7,8-HxCDF	2.7	ng/kg	J	J	Sample result <reporting limit
SITE 11	1018741037	1,2,3,7,8,9-HxCDF	4.7	ng/kg	J	J	Sample result <reporting limit
SITE 11	1018741037	1,2,3,4,7,8-HxCDD	1.1	ng/kg	J	J	Sample result <reporting limit
SITE 11	1018741037	1,2,3,6,7,8-HxCDD	2.0	ng/kg	J	J	Sample result <reporting limit
SITE 11	1018741037	1,2,3,7,8,9-HxCDD	1.8	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,7,8-PeCDF	1.30	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	2,3,4,7,8-PeCDF	1.10	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,7,8-PeCDD	0.48	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,4,7,8-HxCDF	2.60	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,6,7,8-HxCDF	0.78	ng/kg	J	J	Sample result <reporting limit

DUP-2	1018741038	2,3,4,6,7,8-HxCDF	0.61	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,4,7,8-HxCDD	0.84	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,6,7,8-HxCDD	1.60	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,7,8,9-HxCDD	2.00	ng/kg	J	J	Sample result <reporting limit
DUP-2	1018741038	1,2,3,4,7,8,9-HpCDF	0.93	ng/kg	J	J	Sample result <reporting limit
11261-81CM	1018741039	1,2,3,7,8,9-HxCDF	4.8	ng/kg	J	J	Sample result <reporting limit
13337-66CM	1018741040	1,2,3,7,8-PeCDD	2.4	ng/kg	J	J	Sample result <reporting limit
13337-66CM	1018741040	1,2,3,4,7,8-HxCDF	3.9	ng/kg	J	J	Sample result <reporting limit
13337-66CM	1018741040	2,3,4,6,7,8-HxCDF	1.4	ng/kg	J	J	Sample result <reporting limit
13337-66CM	1018741040	1,2,3,7,8,9-HxCDF	1.1	ng/kg	J	J	Sample result <reporting limit
13337-66CM	1018741040	1,2,3,4,7,8-HxCDD	3.2	ng/kg	J	J	Sample result <reporting limit
13337-66CM	1018741040	1,2,3,4,7,8,9-HpCDF	3.6	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,7,8-PeCDF	1.80	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	2,3,4,7,8-PeCDF	1.40	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,7,8-PeCDD	0.31	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,4,7,8-HxCDF	2.10	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,6,7,8-HxCDF	0.82	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	2,3,4,6,7,8-HxCDF	0.58	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,7,8,9-HxCDF	0.77	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,4,7,8-HxCDD	0.56	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,6,7,8-HxCDD	1.20	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,7,8,9-HxCDD	1.30	ng/kg	J	J	Sample result <reporting limit
11193-68CM	1018741042	1,2,3,4,7,8,9-HpCDF	1.20	ng/kg	J	J	Sample result <reporting limit
FW1A	1018741043	Total TCDD	0.47	ng/kg	J	J	Sample result <reporting limit
FW1A	1018741043	Total PeCDD	0.59	ng/kg	J	J	Sample result <reporting limit
FW1A	1018741043	Total HxCDD	0.63	ng/kg	J	J	Sample result <reporting limit

FW1A	1018741043	1,2,3,4,6,7,8-HpCDD	1.60	ng/kg	J	J	Sample result <reporting limit
FW1A	1018741043	Total HpCDD	3.50	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,7,8-PeCDF	0.71	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	2,3,4,7,8-PeCDF	1.00	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,7,8-PeCDD	0.74	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,4,7,8-HxCDF	0.78	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,6,7,8-HxCDF	0.69	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,7,8,9-HxCDF	0.29	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,4,7,8-HxCDD	0.88	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,6,7,8-HxCDD	1.60	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,7,8,9-HxCDD	2.10	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	1,2,3,4,6,7,8-HpCDF	3.40	ng/kg	J	J	Sample result <reporting limit
15244-50&52cm	1018741044	Total HpCDF	3.40	ng/kg	J	J	Sample result <reporting limit

TABLE 3 - AWRL CALCULATION CHECKS

SDG, CCV, File Name & Run Date	Isomer	Area 1 unlabeled	Area 2 unlabeled	Area 1 labeled	Area 2 labeled	Injection Qty. Ratio	RF calc.	ICAL RF_{avg}	AWRL %R	75-125%R Met?
Pace 05-1018741, CS1-0309095, 09/04/2005	2,3,7,8-TCDF	1120000	1490000	255000000	326000000	200	0.8985	0.9401	95.57	Y
	2,3,7,8-TCDD	880000	1120000	162000000	204000000	200	1.0929	1.0184	107.32	Y
	1,2,3,7,8-PeCDF	6030000	3890000	256000000	167000000	40	0.9381	0.9327	100.57	Y
	2,3,4,7,8-PeCDF	6150000	4040000	254000000	164000000	40	0.9751	0.9726	100.26	Y
	1,2,3,7,8-PeCDD	2400000	3910000	160000000	101000000	40	0.9670	0.9942	97.27	Y
	1,2,3,4,7,8-HxCDF	3910000	3270000	88000000	167000000	40	1.1263	1.1363	99.12	Y
	1,2,3,6,7,8-HxCDF	4770000	3730000	115000000	221000000	40	1.0119	1.066	94.93	Y
	2,3,4,6,7,8-HxCDF	4280000	3450000	105000000	205000000	40	0.9974	1.0694	93.27	Y
	1,2,3,7,8,9-HxCDF	3270000	2680000	80200000	150000000	40	1.0339	1.0757	96.11	Y
	1,2,3,4,7,8-HxCDD	2560000	2100000	110000000	86600000	40	0.9481	0.9929	95.49	Y
	1,2,3,6,7,8-HxCDD	3170000	2570000	142000000	113000000	40	0.9004	0.947	95.08	Y
	1,2,3,7,8,9-HxCDD	2910000	2340000	133000000	110000000	40	0.8642	0.9693	89.16	Y
	1,2,3,4,6,7,8-HpCDF	4230000	4280000	78600000	176000000	40	1.3370	1.394	95.91	Y
	1,2,3,4,7,8,9-HpCDF	3370000	2990000	65700000	143000000	40	1.2190	1.2757	95.55	Y
	1,2,3,4,6,7,8-HpCDD	2480000	2450000	98100000	91100000	40	1.0423	1.085	96.06	Y
	OCDF	4630000	5450000	159000000	177000000	40	1.2000	1.3035	92.06	Y
	OCDD	3940000	4360000	159000000	177000000	40	0.9881	1.0572	93.46	Y
AWRL %R = [(area 1 + area 2 unlabeled) / (area 1 + area 2 labeled)] x (ng. labeled/ng. unlabeled) x (1 / ICAL RF_{avg}) x 100%										

DATA VERIFICATION SUMMARY REPORT

FOR

DIOXINS/FURANS SAMPLES

collected from

HOUSTON SHIP CHANNEL

HOUSTON, TEXAS

Data Verifier: Richard Cheatham (Parsons – Denver, CO)

INTRODUCTION

The following data verification summary report covers environmental soil samples collected from the Houston Ship Channel in Houston, Texas on August 16 and August 30, 2005. The samples were received by Pace Analytical Services, Inc., Minneapolis, MN on September 08, 2005 and analyzed for Dioxins/Furans using Method EPA 1613B (modified). Analysis results for seven (7) soil samples were reported in the following laboratory Sample Delivery Group (SDG): 05-1019347. Sample identification numbers and sample collection dates are summarized on Table 1. Recommended data qualifiers are summarized on Table 2.

All samples were collected by Parsons following the procedures described in the QAPP. All analyses were performed by Pace Analytical in Minneapolis, Minnesota following procedures outlined in the QAPP.

EVALUATION CRITERIA

The data submitted by the laboratory has been reviewed and verified following the guidelines outlined in the QAPP and National Functional Guidelines for Organic and Inorganic Data (EPA 1994). Information reviewed in the data packages include sample results; the laboratory quality control results; instrument calibrations; blanks; case narrative and chain-of-custody forms. The validation protocol addressed the following parameters: method blanks, laboratory control spike recoveries, recoveries of labeled compounds (internal standards), instrument calibrations, continuing calibration verifications, MS/MSD results, field duplicate sample results, and AWRL check standard results. The analyses and findings presented in this report are based on the reviewed information, and meeting guidelines in the QAPP (with the exceptions noted below).

DIOXINS AND FURANS

General

The SDG included in this report, 05-1019347, consisted of seven (7) soil samples analyzed for Dioxins/Furans (PCDD/PCDF) using USEPA Method 1613B (modified). All samples for this SDG were collected and analyzed following the procedures and protocols outlined in the QAPP. All samples collected were prepared and analyzed within the holding times required by the method.

Accuracy

Accuracy was evaluated using the %R results for the laboratory control sample (LCS), matrix spike/matrix spike duplicates (MS/MSDs), and labeled compound spikes.

- The LCS results met criteria (laboratory control limits); recoveries for 1,2,3,6,7,8_HxCDD (126%R), 1,2,3,4,7,8,9-HpCDF (126%R), and OCDF (126%R) were slightly above the QAPP control limit (75-125%R). Sample results were not affected and were not qualified. One LCS sample was analyzed with this SDG.
- Sample SITE 10 was utilized for MS/MSD analyses. MS/MSD recoveries were within acceptance limits (QAPP Table A-2), with exception of 2,3,7,8-TCDF, 2,3,7,8-TCDD, and OCDD for which sample concentrations were greater than 500x spike amount so MS/MSD recoveries and RPD value results were not meaningful. No sample results were qualified.
- Labeled compound spike (internal standard) recoveries met advisory criteria (Method 1613B). The 2,3,7,8-substituted congeners are quantified based on isotope dilution. Therefore, the sample results were not qualified.
- In those instances where a PCDF compound and "interference" were both identified, the laboratory correctly reported the sample results as "estimated maximum possible concentration" (EMPC) values, rather than as a "concentration" value.

Precision

Analytical precision was evaluated using the Relative Percent Difference (RPD) values obtained from laboratory duplicate analyses and from matrix spiked samples (MS/MSD). Evaluation results are as follows:

- The MS/MSD RPD values were within acceptance criteria of lab duplicate samples ($\leq$25% RPD) for sample SITE 10, with the exception of 2,3,7,8-TCDF and 2,3,7,8-TCDD for which sample concentrations were greater than 4x spike amount so MS/MSD recovery RPD value results were not meaningful. No sample results were qualified.

- The following field sample was analyzed as a laboratory duplicate sample as part of this SDG: 11280-0.2-0.4FT. Laboratory duplicate sample analysis results were within acceptance criteria of lab duplicate samples (<25%RPD for results >AWRL) with the exceptions shown below. Results that exceeded the criterion were flagged as estimates ("J") for the parent sample.

Sample	Analyte	RPD
11280-0.2-0.4FT	2,3,7,8-TCDF	41.0
11280-0.2-0.4FT	Total TCDF	40.0
11280-0.2-0.4FT	2,3,7,8-TCDD	46.6
11280-0.2-0.4FT	Total TCDD	40.0
11280-0.2-0.4FT	1,2,3,7,7-PeCDF	74.3
11280-0.2-0.4FT	2,3,4,7,8-PeCDF	40.0
11280-0.2-0.4FT	Total PeCDF	13.3
11280-0.2-0.4FT	Total PeCDD	6.5
11280-0.2-0.4FT	1,2,3,4,7,8-HxCDF	71.3
11280-0.2-0.4FT	1,2,3,6,7,8-HxCDF	58.1
11280-0.2-0.4FT	1,2,3,7,8,9-HxCDF	100.0
11280-0.2-0.4FT	Total HxCDF	57.1
11280-0.2-0.4FT	1,2,3,4,7,8-HxCDD	44.0
11280-0.2-0.4FT	Total HxCDD	14.3
11280-0.2-0.4FT	1,2,3,4,6,7,8-HpCDF	28.2
11280-0.2-0.4FT	Total HpCDF	36.4
11280-0.2-0.4FT	1,2,3,4,6,7,8-HpCDD	34.9
11280-0.2-0.4FT	Total HpCDD	40.0
11280-0.2-0.4FT	OCDF	37.7
11280-0.2-0.4FT	OCDD	34.5

Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represents actual site conditions. Representativeness has been evaluated by:

- Comparing the chain-of-custody procedures to those described in the QAPP;
- Evaluating holding times; and
- Examining method blanks for contamination of samples during analysis.

The samples in all SDGs were collected and analyzed following the QAPP, COC and analytical procedures. All samples were prepared and analyzed with the holding times required for the analysis.

- Analytical holding time of 1-yr. from sample collection was met.

- All method blank criteria were met. In the method blank associated with this SDG, no analytes were reported at levels above the AWRL. The following analytes/parameters were reported at levels below the reporting limit: total

TCDD (0.20J), Total PeCDD (0.19J), Total HxCDF (0.16J), Total HxCDD (0.25J), and OCDD (4.40J). Associated sample results <20X blank concentration have been qualified with a "B" qualifier to denote method blank contamination.

- All initial calibration criteria were met.
- All continuing calibration criteria were met
- All AWRL standard criteria were met. AWRL calculation checks are presented on Table 3.

Completeness

Completeness has been evaluated by comparing the total number of samples collected with the total number of samples with valid analytical data.

No reported results for samples in this SDG have been rejected or invalidated (qualified "R"). The completeness for this SDG is 100% compared to the minimum acceptance limit of 90%.

TABLE 1 – VALIDATED SAMPLES AND ANALYTICAL PARAMETERS

Field Sample ID	Sample Type	Collection Date	Sample Matrix	Pace SDG	Pace Sample ID	Pace Sample Receipt Date	Sample Prep (Extraction Date)	PCDD/PCDF Analysis Date
SITE 10		08/30/05	Soil	05-1019347	1019347001	09/08/05	10/11/05	10/15/05
SITE 12		08/30/05	Soil	05-1019347	1019347002	09/08/05	10/11/05	10/15/05
11280-0-0.2 FT		08/16/05	Soil	05-1019347	1019347003	09/08/05	10/11/05	10/16/05
11280 0.2-0.4 FT		08/16/05	Soil	05-1019347	1019347004	09/08/05	10/11/05	10/16/05
11280 0.4-0..6 FT		08/16/05	Soil	05-1019347	1019347005	09/08/05	10/11/05	10/16/05
11280 0.6-0.8 FT		08/16/05	Soil	05-1019347	1019347006	09/08/05	10/11/05	10/16/05
11280 0.8-0.94 FT		08/16/05	Soil	05-1019347	1019347007	09/08/05	10/11/05	10/16/05

TABLE 2 - SUMMARY OF QUALIFIED DATA

Sample ID	Lab Sample ID	Analyte	Result	Units	Lab Flag	Data Qualifier	Reason
SITE 10	1019347001	1,2,3,6,7,8-HxCDF	3.50	ng/kg	J	J	Sample result <reporting limit
SITE 10	1019347001	2,3,4,6,7,8-HxCDF	1.10	ng/kg	J	J	Sample result <reporting limit
SITE 10	1019347001	1,2,3,7,8,9-HxCDF	1.80	ng/kg	J	J	Sample result <reporting limit
SITE 10	1019347001	1,2,3,4,7,8-HxCDD	0.96	ng/kg	J	J	Sample result <reporting limit
SITE 10	1019347001	1,2,3,6,7,8-HxCDD	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 10	1019347001	1,2,3,7,8,9-HxCDD	2.40	ng/kg	J	J	Sample result <reporting limit
SITE 10	1019347001	1,2,3,4,7,8,9-HpCDF	2.30	ng/kg	J	J	Sample result <reporting limit
SITE 12	1019347002	1,2,3,7,8-PcCDF	3.90	ng/kg	J	J	Sample result <reporting limit
SITE 12	1019347002	2,3,4,7,8-PeCDF	3.70	ng/kg	J	J	Sample result <reporting limit
SITE 12	1019347002	1,2,3,7,8-PeCDD	0.92	ng/kg	J	J	Sample result <reporting limit
SITE 12	1019347002	1,2,3,6,7,8-HxCDF	2.40	ng/kg	J	J	Sample result <reporting limit
SITE 12	1019347002	2.3.4.6.7.8-HxCDF	1.70	ng/kg	J	J	Sample result <reporting limit
SITE 12	1019347002	1,2,3,7,8,9-HxCDF	0.90	ng/kg	J	J	Sample result <reporting limit
SITE 12	1019347002	1,2,3,4,7,8,9-HpCDF	3.80	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	Total TCDD	0.30	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	Total PcCDF	0.36	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	1,2,3,4,7,8-HxCDF	0.26	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	1,2,3,6,7,8-HxCDF	0.17	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	Total HxCDF	1.50	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	1,2,3,7,8,9-HxCDD	0.31	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	Total HxCDD	2.60	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	1,2,3,4,6,7,8-HpCDF	0.71	ng/kg	J	J	Sample result <reporting limit
11280-0-0.2FT	1019347003	Total HpCDF	2.50	ng/kg	J	J	Sample result <reporting limit

11280-0-0.2FT	1019347003	OCDF	2.90	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	1,2,3,7,8-PeCDF	3.30	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	2,3,4,7,8-PeCDF	2.60	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	13DD	0.69	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	Total PeCDD	1.50	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	1,2,3,4,7,8-HxCDF	3.70	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	1,2,3,6,7,8-hxCDF	1.10	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	1,2,3,7,,9-HxCDF	0.40	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	1,2,3,4,7,8-HxCDD	0.61	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	1,2,3,4,7,8,9-HpCDF	0.93	ng/kg	J	J	Sample result <reporting limit
11280-0.6-0.8FT	1019347006	1,2,3,7,8-PeCDD	4.8	ng/kg	J	J	Sample result <reporting limit
11280-0.6-0.8FT	1019347006	2,3,4,6,7,8-HxCDF	2.2	ng/kg	J	J	Sample result <reporting limit
11280-0.6-0.8FT	1019347006	1,2,3,7,8,9-HxCDF	3.8	ng/kg	J	J	Sample result <reporting limit
11280-0.6-0.8FT	1019347006	1,2,3,4,7,8-HxCDD	3.7	ng/kg	J	J	Sample result <reporting limit
11280-0.8-0.94FT	1019347007	1,2,3,7,8-PeCDF	1.00	ng/kg	J	J	Sample result <reporting limit
11280-0.8-0.94FT	1019347007	2,3,4,7,8-PeCDF	0.98	ng/kg	J	J	Sample result <reporting limit
11280-0.8-0.94FT	1019347007	Total PeCDD	0.20	ng/kg	J	J	Sample result <reporting limit
11280-0.8-0.94FT	1019347007	1,2,3,4,7,8-HxCDF	1.30	ng/kg	J	J	Sample result <reporting limit
11280-0.8-0.94FT	1019347007	1,2,3,6,7,8-HxCDF	0.44	ng/kg	J	J	Sample result <reporting limit
11280-0.8-0.94FT	1019347007	1,2,3,7,8,9-HxCDD	0.65	ng/kg	J	J	Sample result <reporting limit
11280-0.8-0.94FT	1019347007	1,2,3,4,6,7,8-HpCDF	3.50	ng/kg	J	J	Sample result <reporting limit
11280-0.2-0.4FT	1019347004	2,3,7,8-TCDF	100.0	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total TCDF	210.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	2,3,7,8-TCDD	45.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total TCDD	48.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	1,2,3,7,8-PeCDF	3.30	ng/kg	J	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	2,3,4,7,8-PeCDF	2.60	ng/kg	J	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total PeCDF	14.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total PeCDD	1.50	ng/kg	J	J	Lab Dup RPD

11280-0.2-0.4FT	1019347004	1,2,3,4,7,8-HxCDF	3.70	ng/kg	J	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	1,2,3,6,7,8-HxCDF	1.10	ng/kg	J	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	1,2,3,7,8,9-HxCDF	0.40	ng/kg	J	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total HxCDF	10.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	1,2,3,4,7,8-HxCDD	0.61	ng/kg	J	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total HxCDD	15.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	1,2,3,4,6,7,8-HpCDF	8.50	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total HpCDF	26.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	1,2,3,4,6,7,8-HpCDD	37.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	Total HpCDD	120.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	OCDF	63.00	ng/kg	-	J	Lab Dup RPD
11280-0.2-0.4FT	1019347004	OCDD	510.00	ng/kg	-	J	Lab Dup RPD
11280-0-0.2FT	1019347003	Total TCDD	0.30	ng/kg	B	B	Method blank
11280-0-0.2FT	1019347003	Total HxCDF	1.50	ng/kg	B	B	Method blank
11280-0-0.2FT	1019347003	Total HxCDD	2.60	ng/kg	B	B	Method blank
11280-0-0.2FT	1019347003	OCDD	55.00	ng/kg	B	B	Method blank
11280-0.2-0.4FT	1019347004	Total PeCDD	1.50	ng/kg	B	B	Method blank
11280-0.2-0.4FT	1019347004	Total PeCDD	1.60	ng/kg	B	B	Method blank

TABLE 3 - AWRL CALCULATION CHECKS

SDG, CCV, File Name & Run Date	Isomer	Area 1 unlabeled	Area 2 unlabeled	Area 1 labeled	Area 2 labeled	Injection Qty. Ratio	RF calc.	ICAL RF_{avg}	AWRL %R	75-125%R Met?
Pace 05-1019347, CS1-0309095, 10/15/2005	2,3,7,8-TCDF	402000	488000	84100000	108000000	200	0.9266	0.9858	93.99	Y
	2,3,7,8-TCDD	294000	334000	50200000	63900000	200	1.1008	1.0984	100.22	Y
	1,2,3,7,8-PeCDF	1680000	1170000	73300000	46700000	40	0.9500	0.9755	97.39	Y
	2,3,4,7,8-PeCDF	1760000	1110000	74700000	47100000	40	0.9425	1.0169	92.69	Y
	1,2,3,7,8-PeCDD	638000	989000	41500000	26100000	40	0.9627	1.0613	90.71	Y
	1,2,3,4,7,8-HxCDF	1160000	831000	24300000	47500000	40	1.1092	1.1572	95.85	Y
	1,2,3,6,7,8-HxCDF	1300000	1150000	31900000	60700000	40	1.0583	1.0925	96.87	Y
	2,3,4,6,7,8-HxCDF	1140000	974000	29000000	55300000	40	1.0031	1.0997	91.21	Y
	1,2,3,7,8,9-HxCDF	966000	748000	21400000	41000000	40	1.0987	1.092	100.62	Y
	1,2,3,4,7,8-HxCDD	679000	527000	28400000	21700000	40	0.9629	1.0448	92.16	Y
	1,2,3,6,7,8-HxCDD	827000	694000	37000000	29100000	40	0.9204	0.97	94.89	Y
	1,2,3,7,8,9-HxCDD	708000	597000	33600000	27000000	40	0.8614	0.943	91.35	Y
	1,2,3,4,6,7,8-HpCDF	948000	956000	17600000	39000000	40	1.3456	1.451	92.73	Y
	1,2,3,4,7,8,9-HpCDF	723000	762000	15200000	32800000	40	1.2375	1.2924	95.75	Y
	1,2,3,4,6,7,8-HpCDD	513000	497000	20000000	18900000	40	1.0386	1.1389	91.19	Y
	OCDF	1140000	1230000	35000000	37400000	40	1.3094	1.3903	94.18	Y
	OCDD	903000	999000	35000000	37400000	40	1.0508	1.0789	97.40	Y

APPENDIX B
DISTRIBUTIONS OF 2005 AND 2010 DATA FOR DIOXINS AND FURANS IN SURFACE SEDIMENTS

2,3,7,8–TCDD

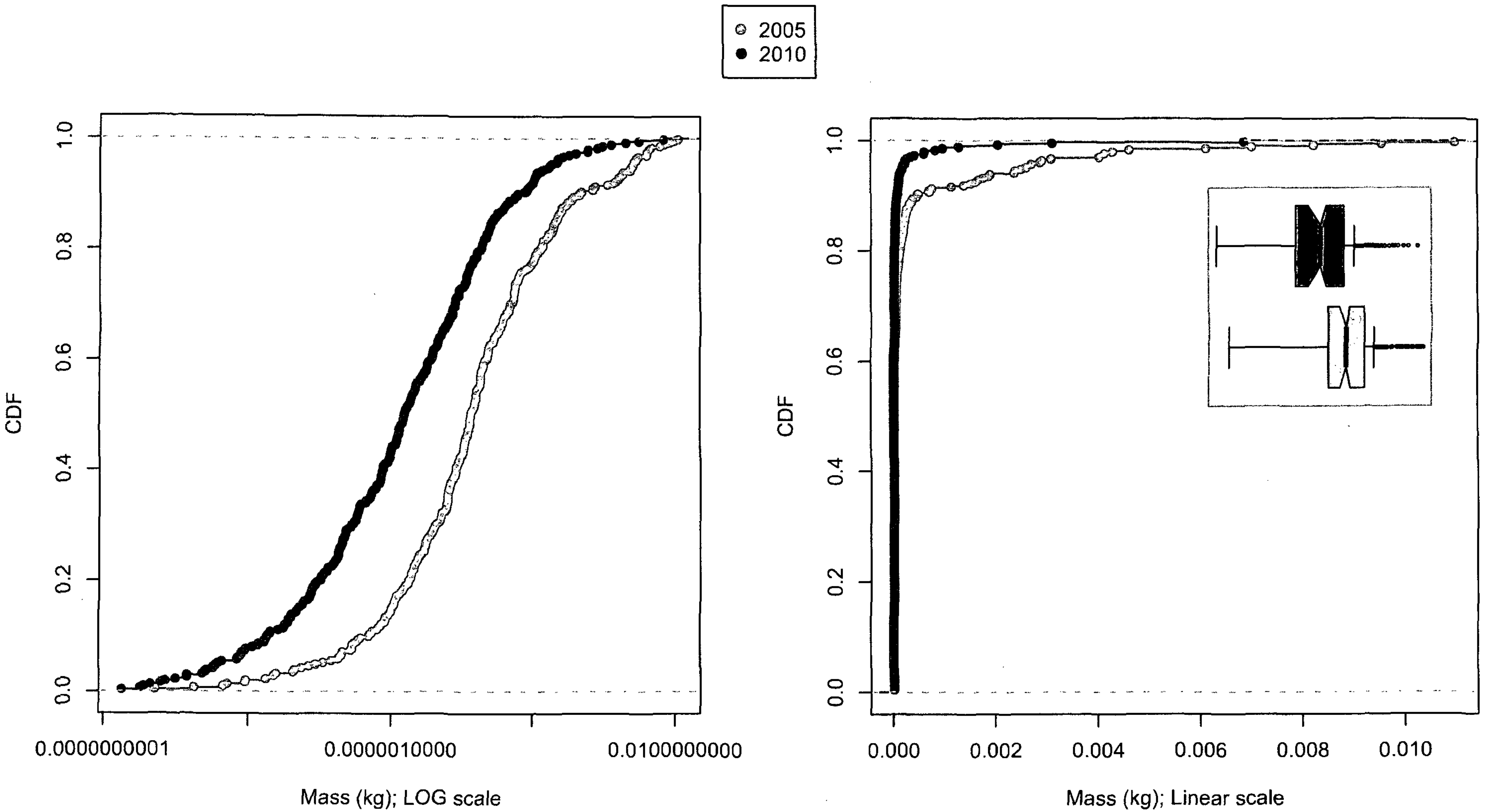

Figure B1
Comparison of 2,3,7,8–TCDD mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,7,8-PeCDD

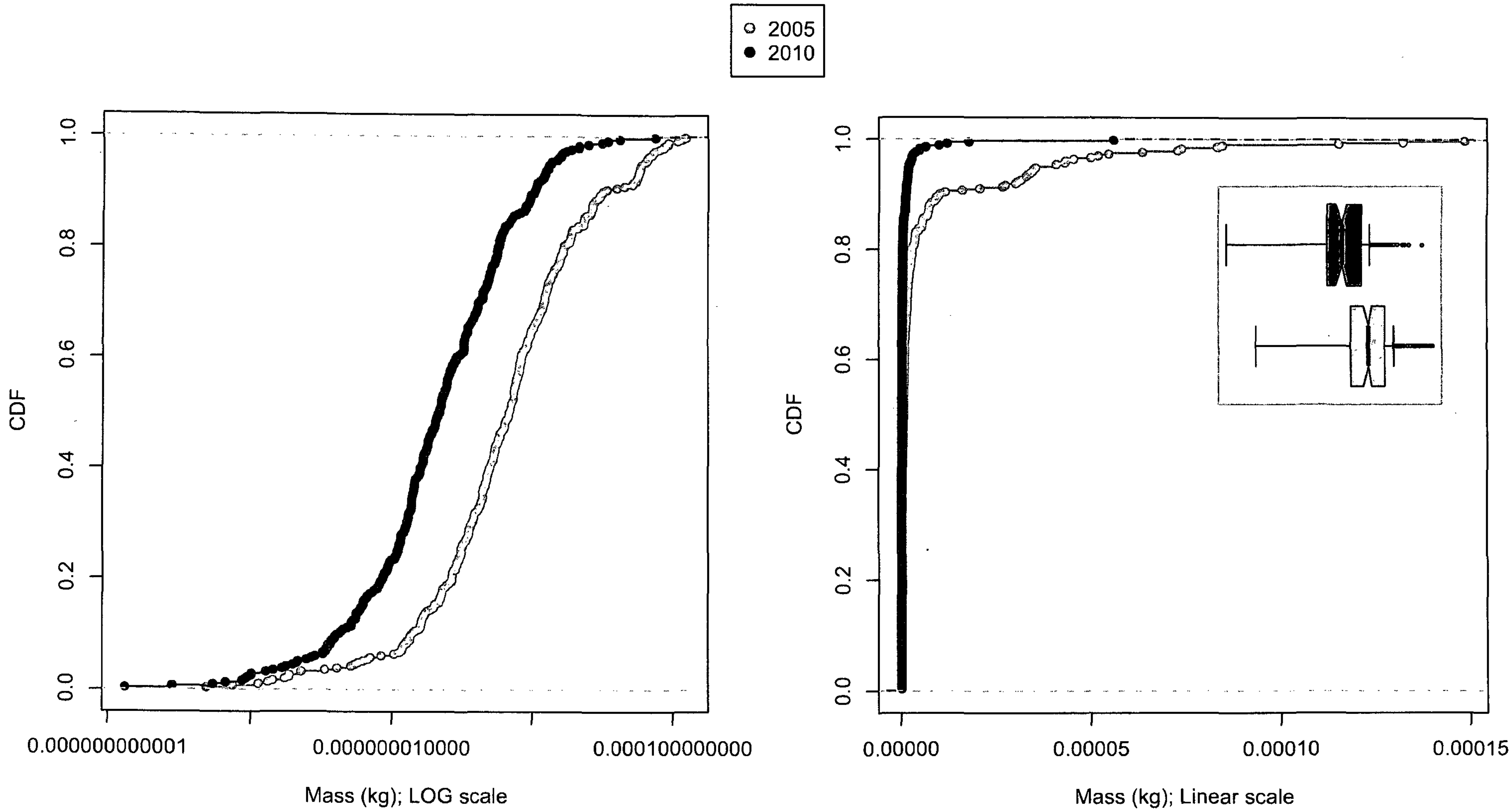

Figure B2
Comparison of 1,2,3,7,8-PeCDD mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,6,7,8-HxCDD

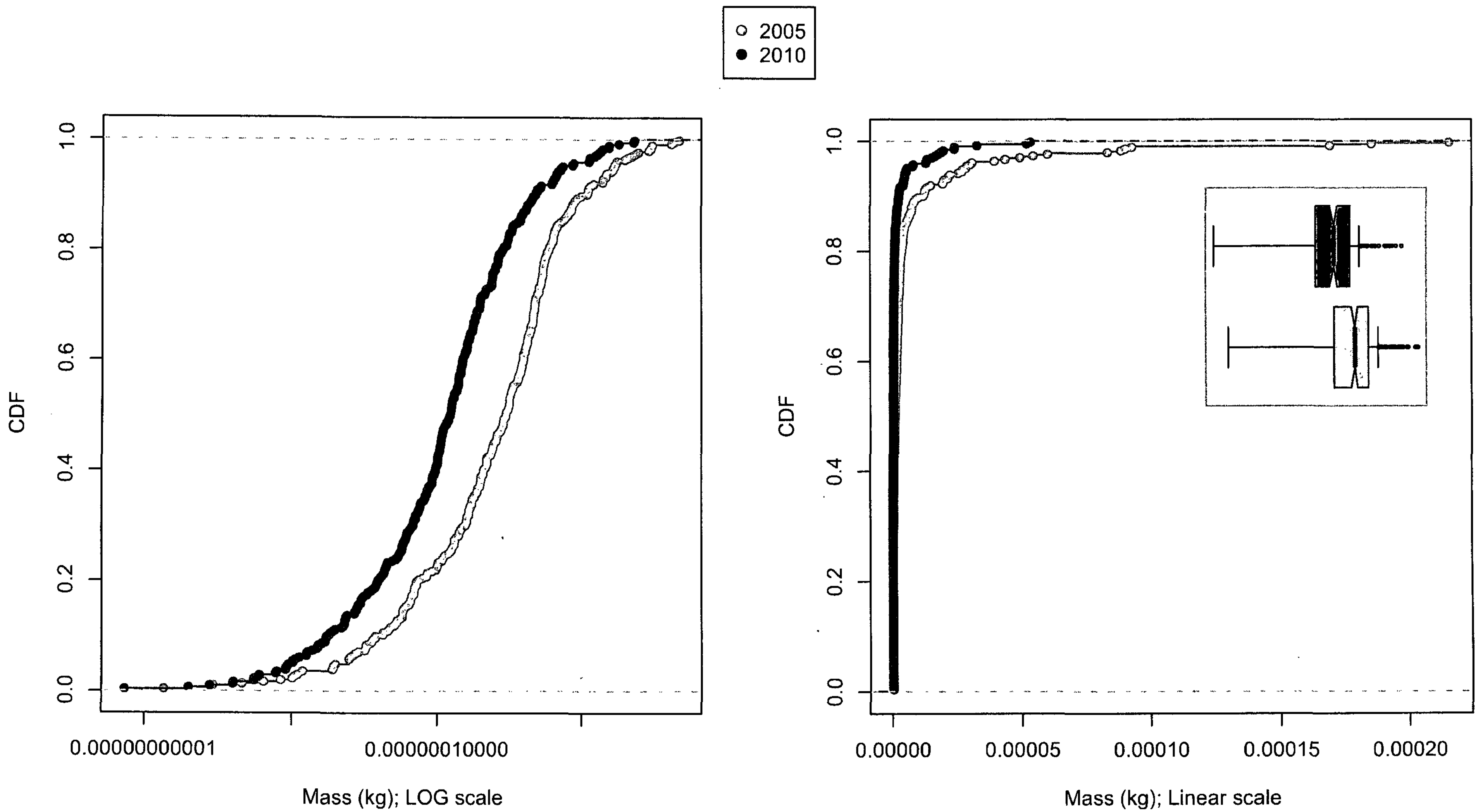

Figure B4
Comparison of 1,2,3,6,7,8−HxCDD mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,7,8,9-HxCDD

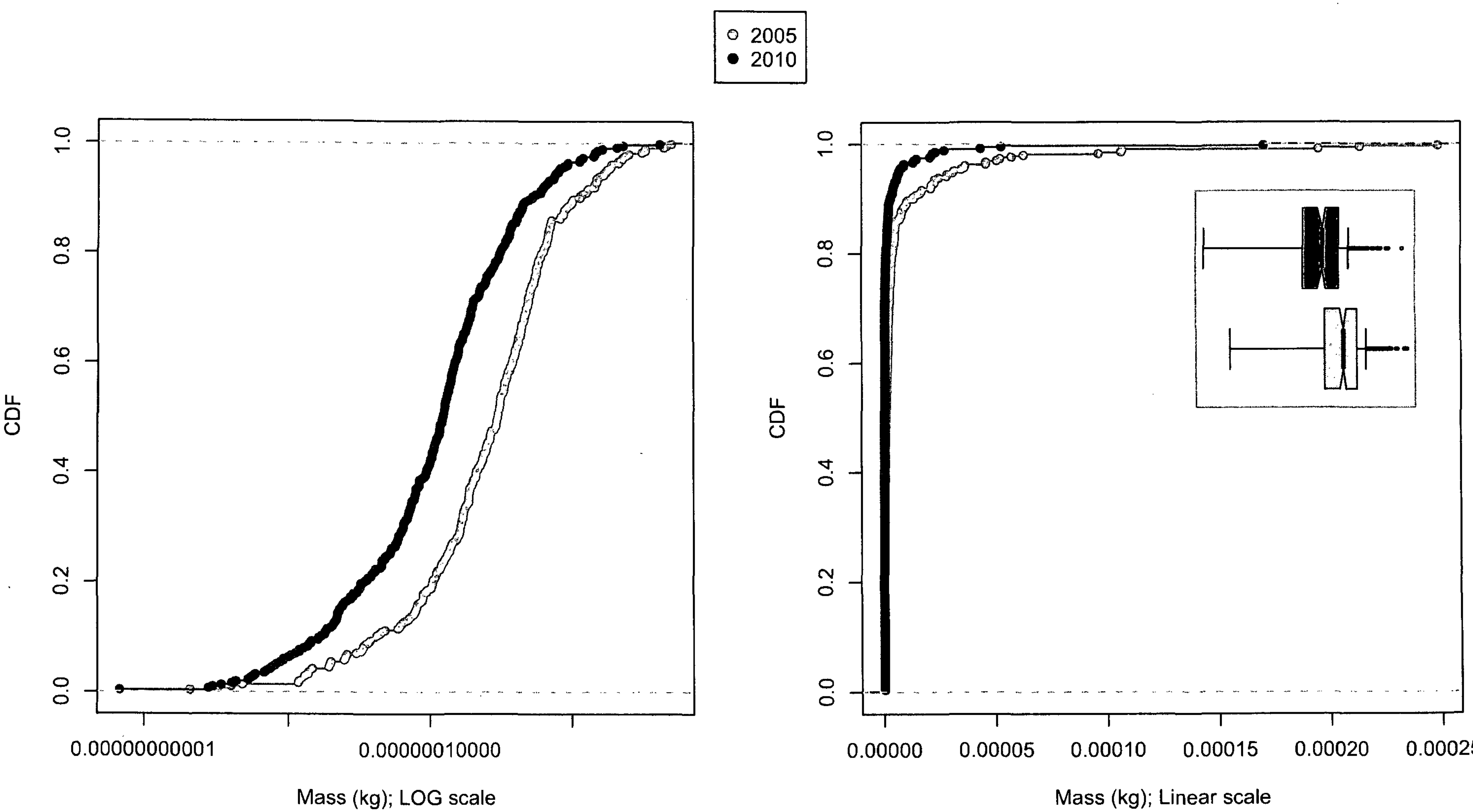

Figure B5
Comparison of 1,2,3,7,8,9−HxCDD mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,4,6,7,8−HpCDD

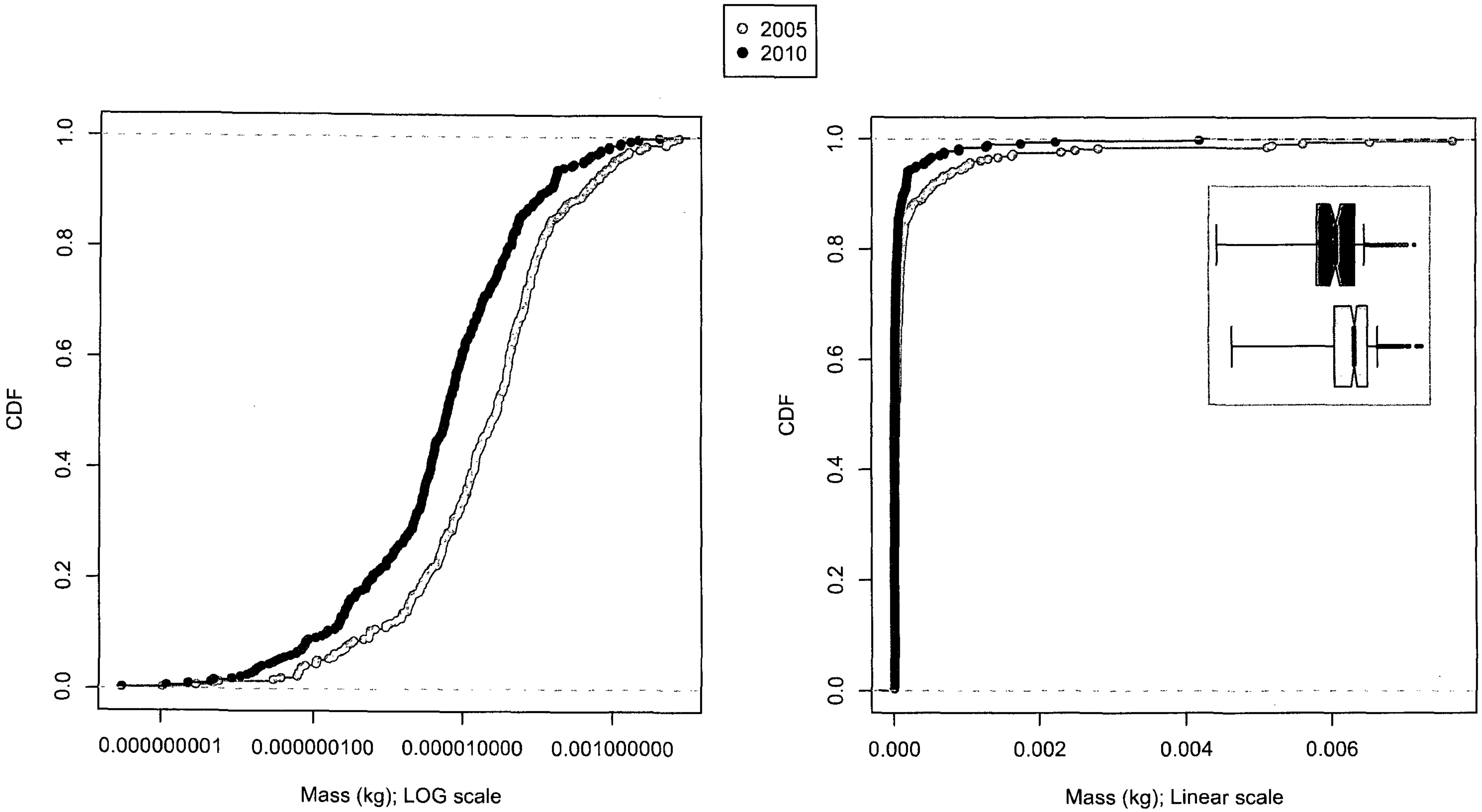

Figure B6
Comparison of 1,2,3,4,6,7,8−HpCDD mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

OCDD

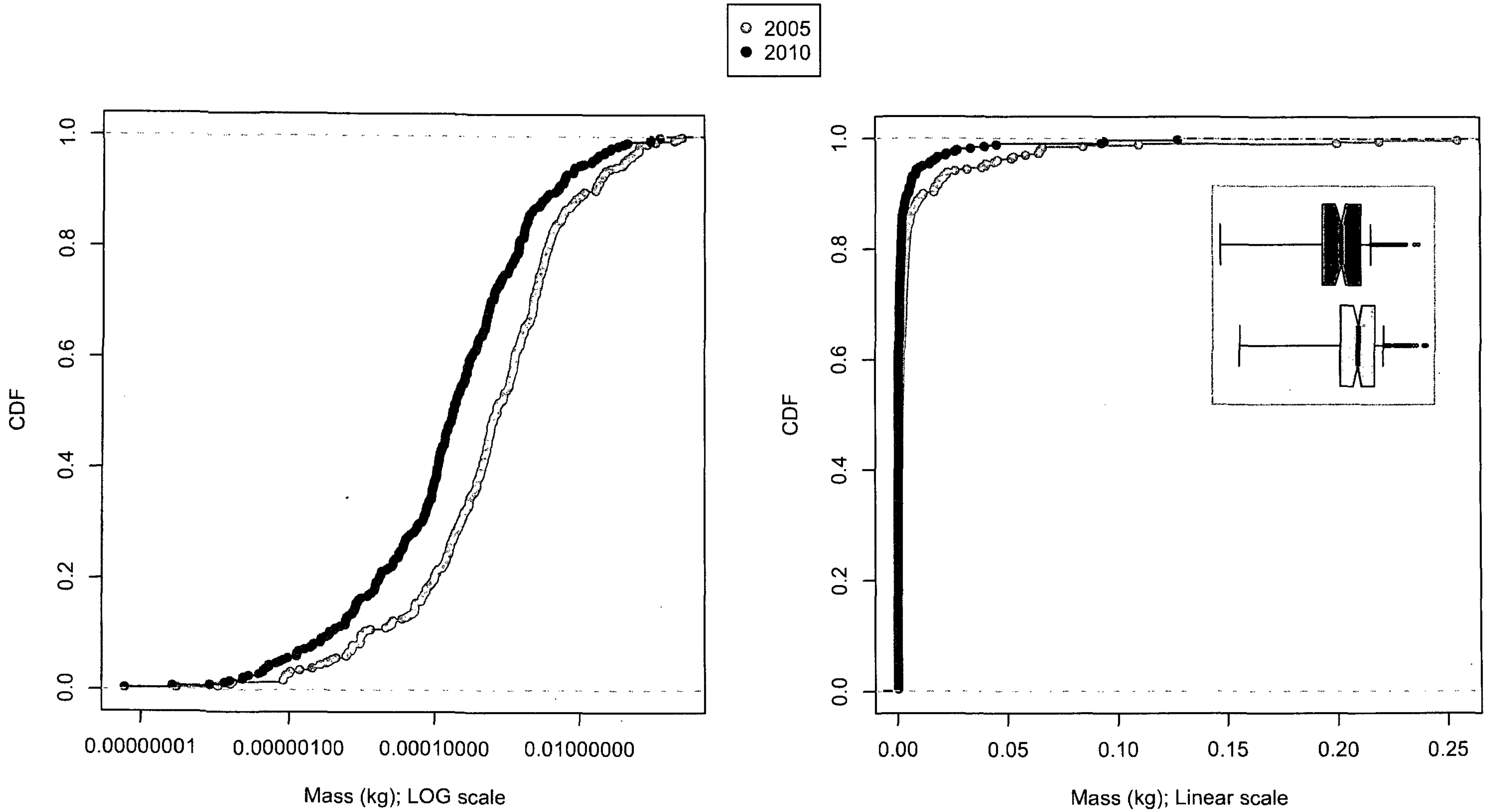

Figure B7
Comparison of OCDD mass in each Thiessen polygon
corresponding to both a 2005 and a 2010 surface sediment sample

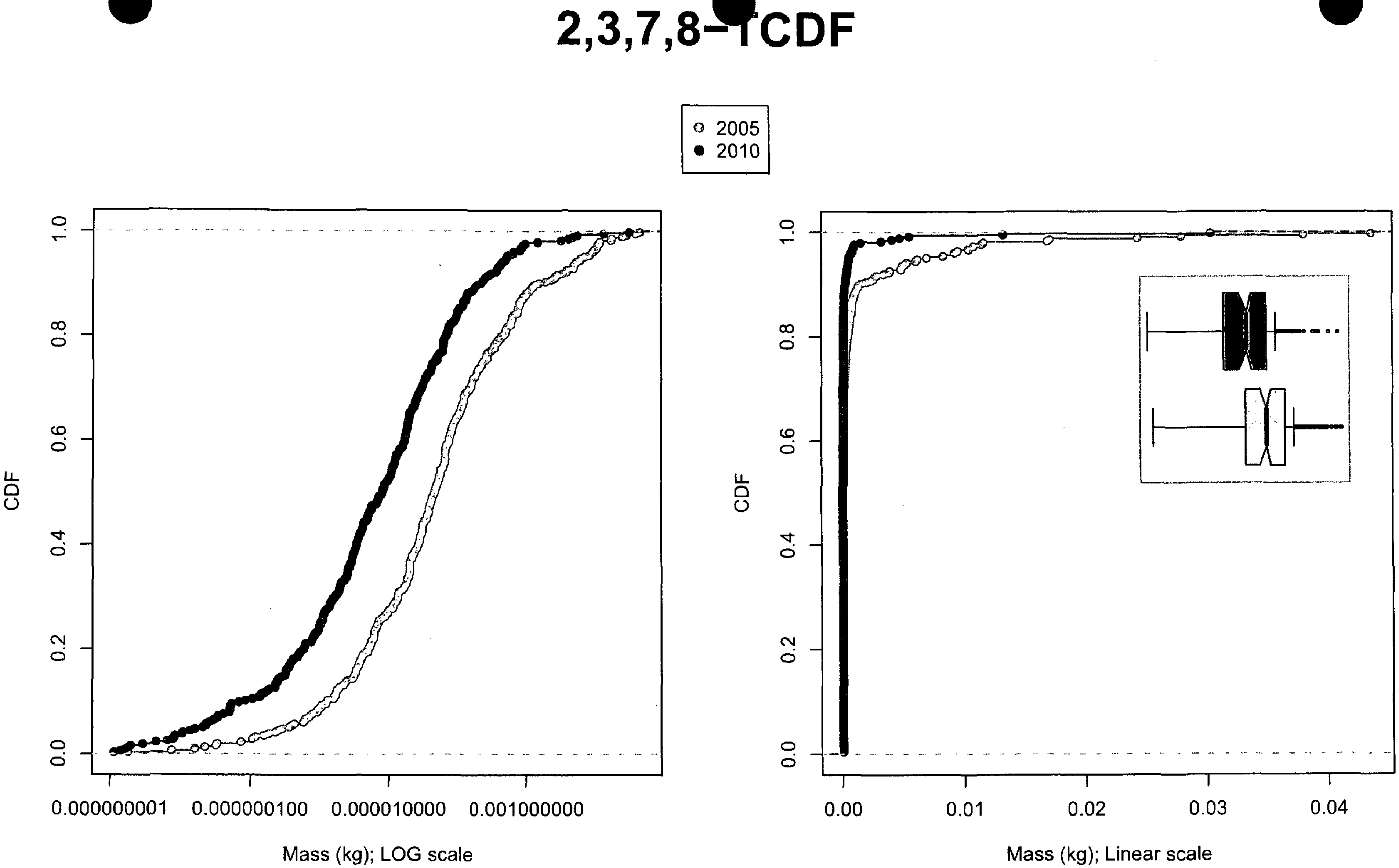

Figure B8
Comparison of 2,3,7,8-TCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

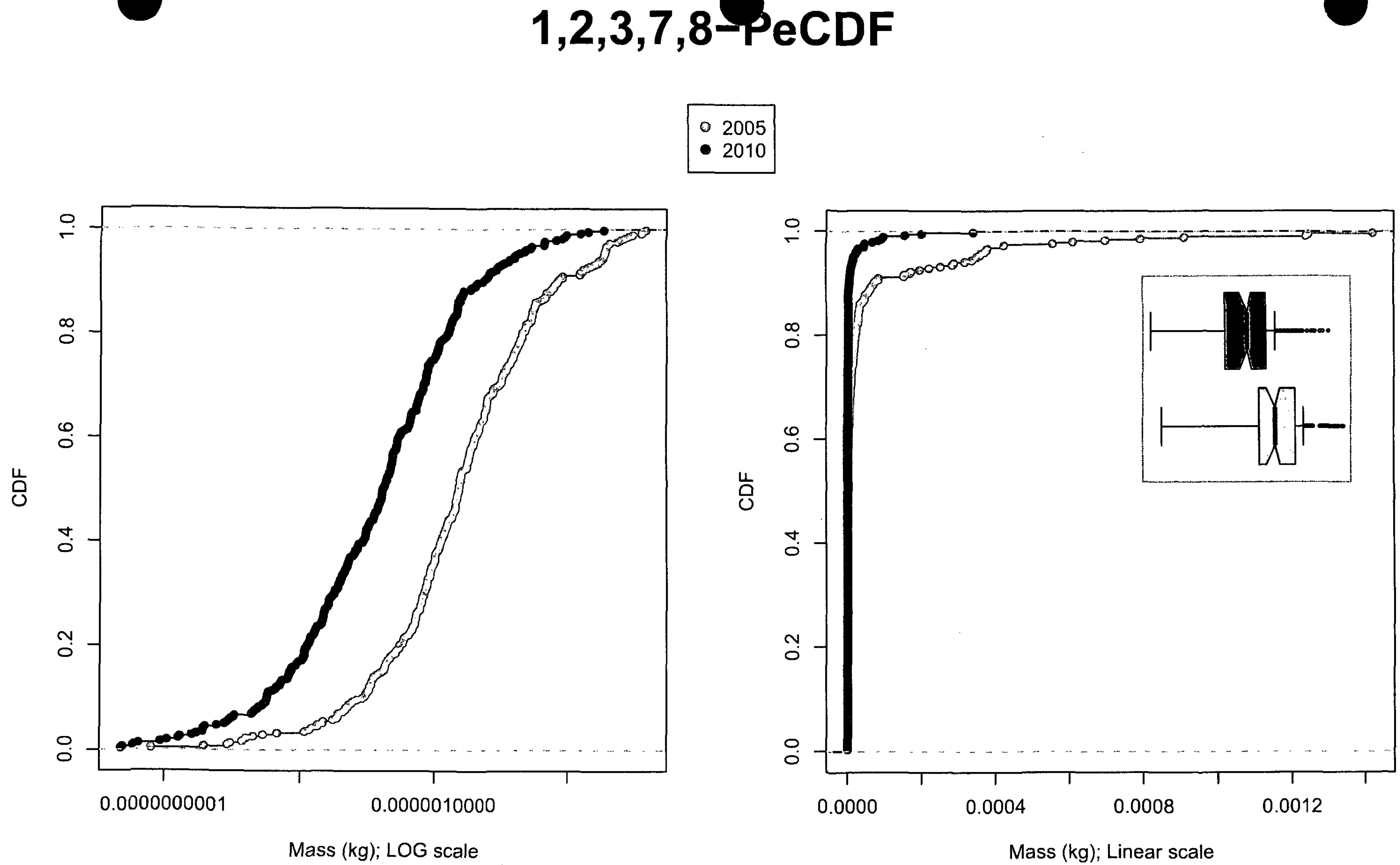

Figure B9
Comparison of 1,2,3,7,8−PeCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

2,3,4,7,8-PeCDF

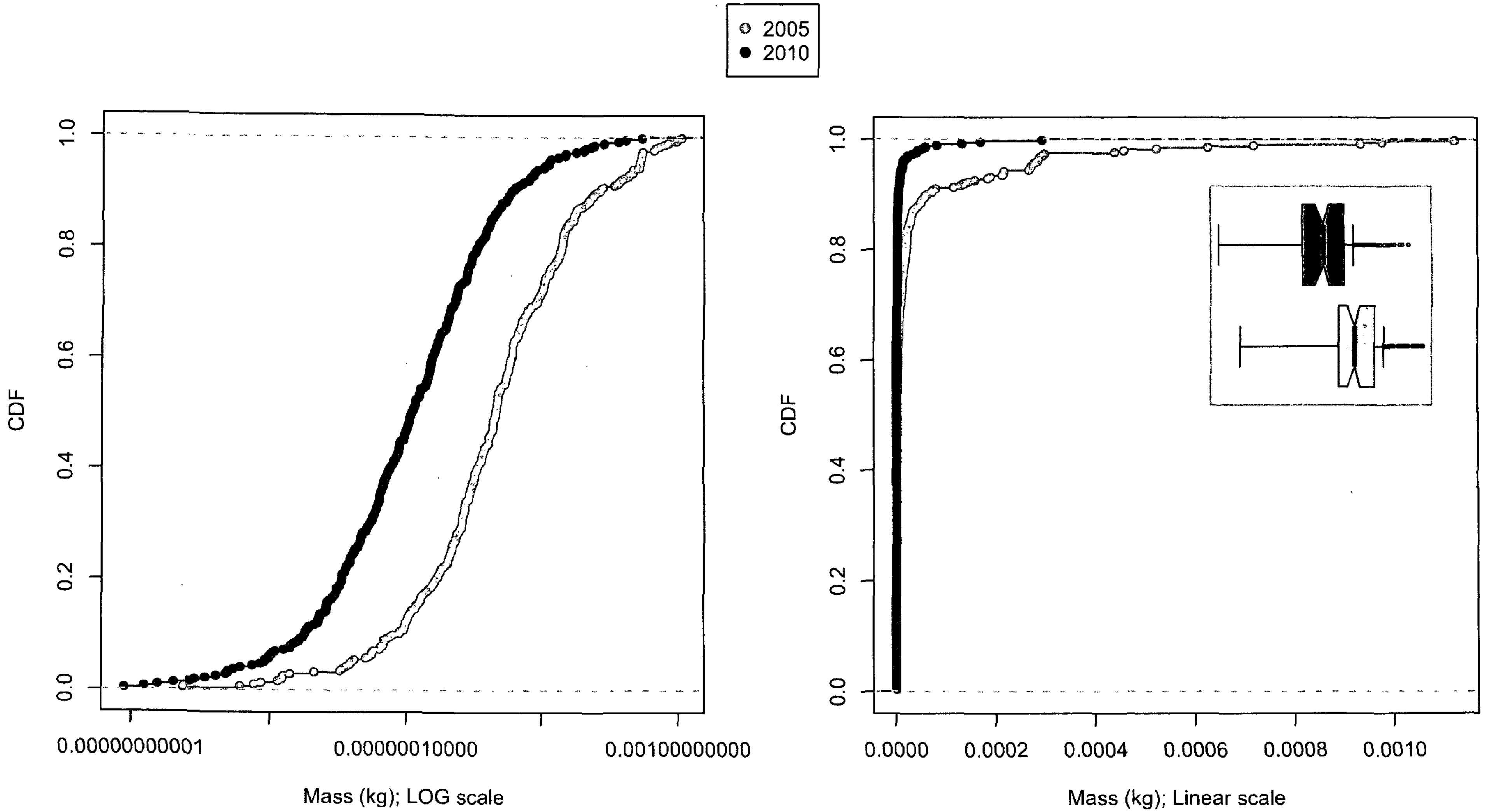

Figure B10
Comparison of 2,3,4,7,8-PeCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,4,7,8−HxCDF

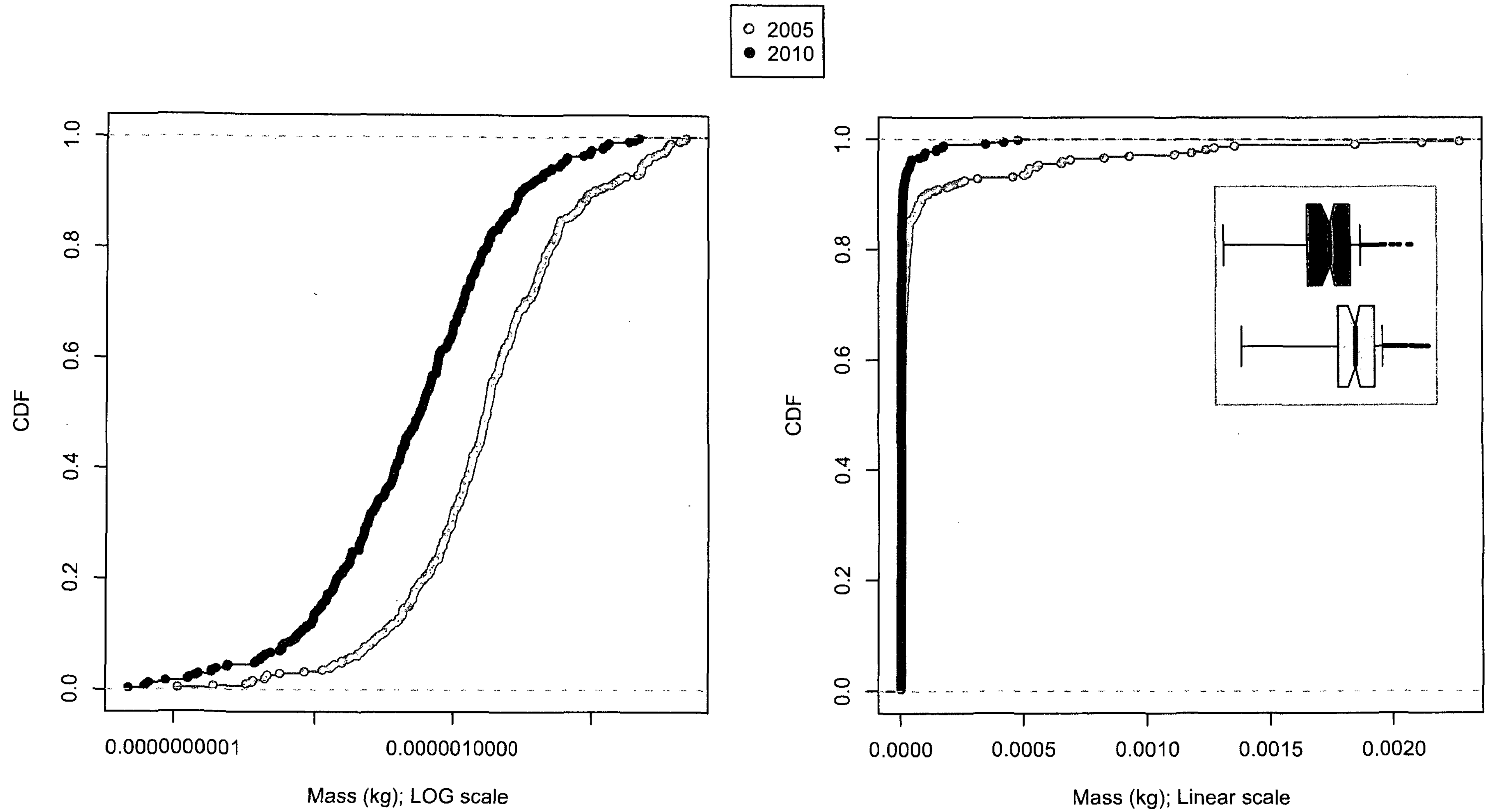

Figure B11
Comparison of 1,2,3,4,7,8−HxCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,6,7,8-HxCDF

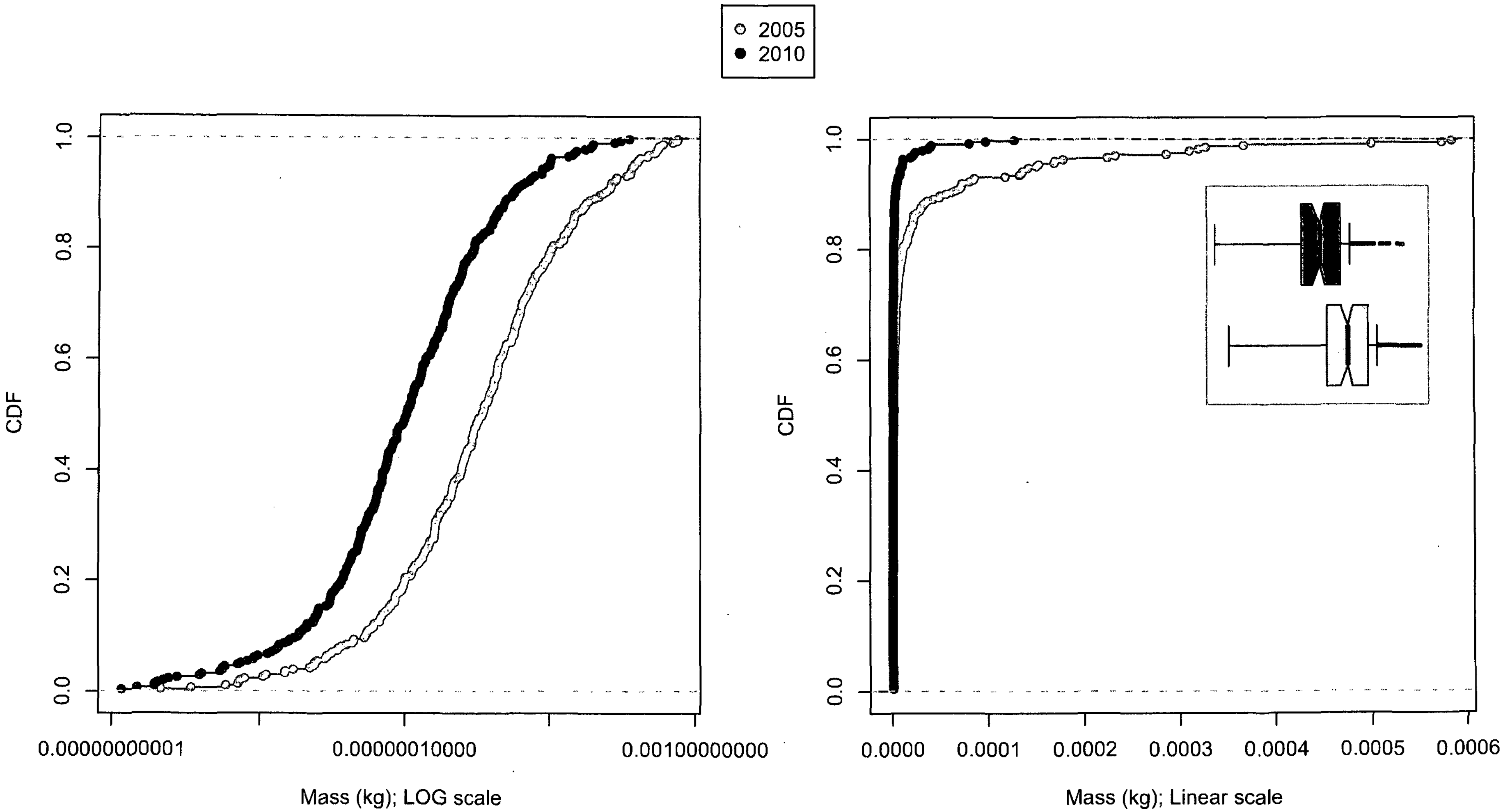

Figure B12
Comparison of 1,2,3,6,7,8-HxCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,7,8,9-HxCDF

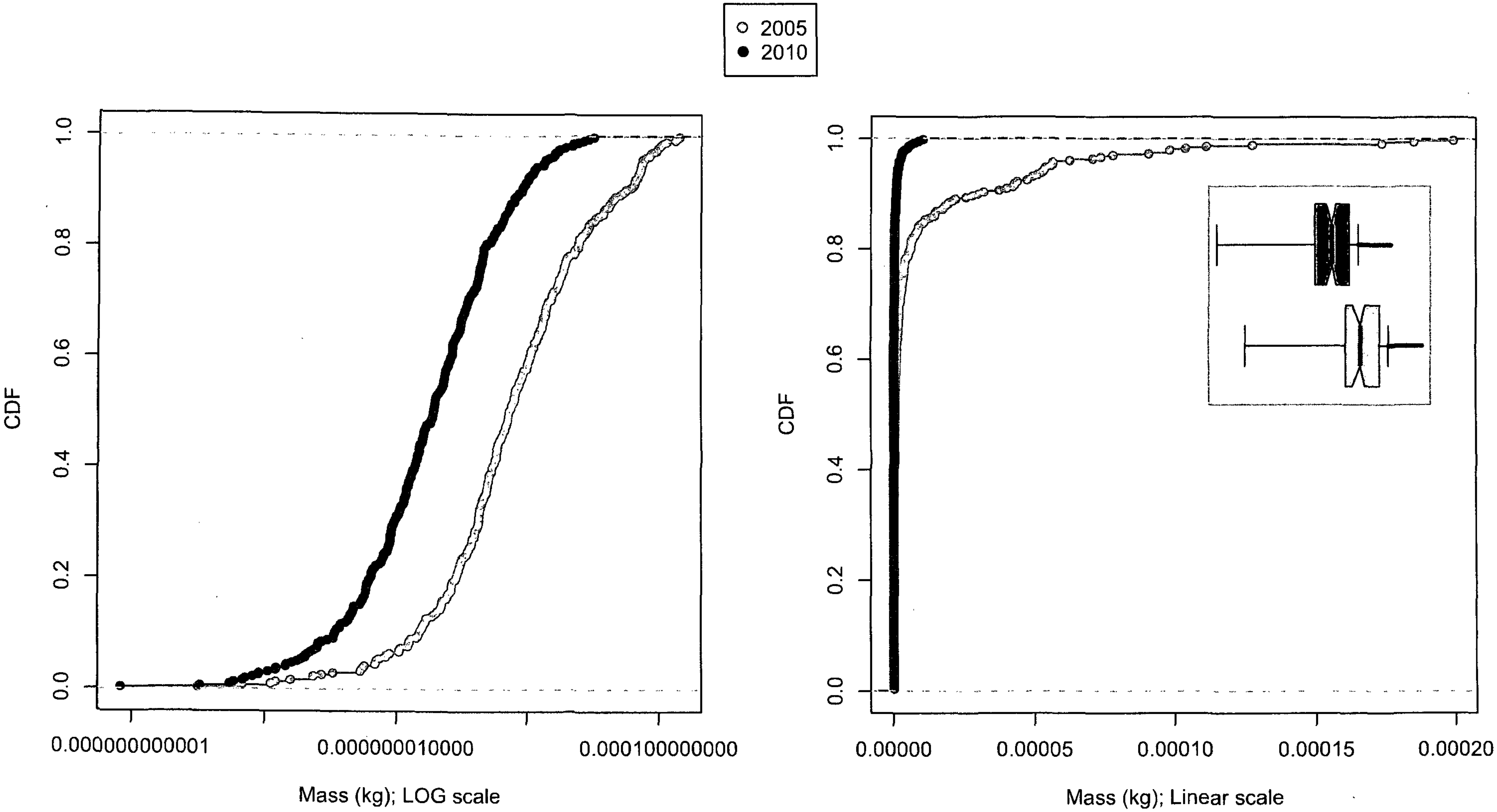

Figure B13
Comparison of 1,2,3,7,8,9-HxCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

2,3,4,6,7,8-HxCDF

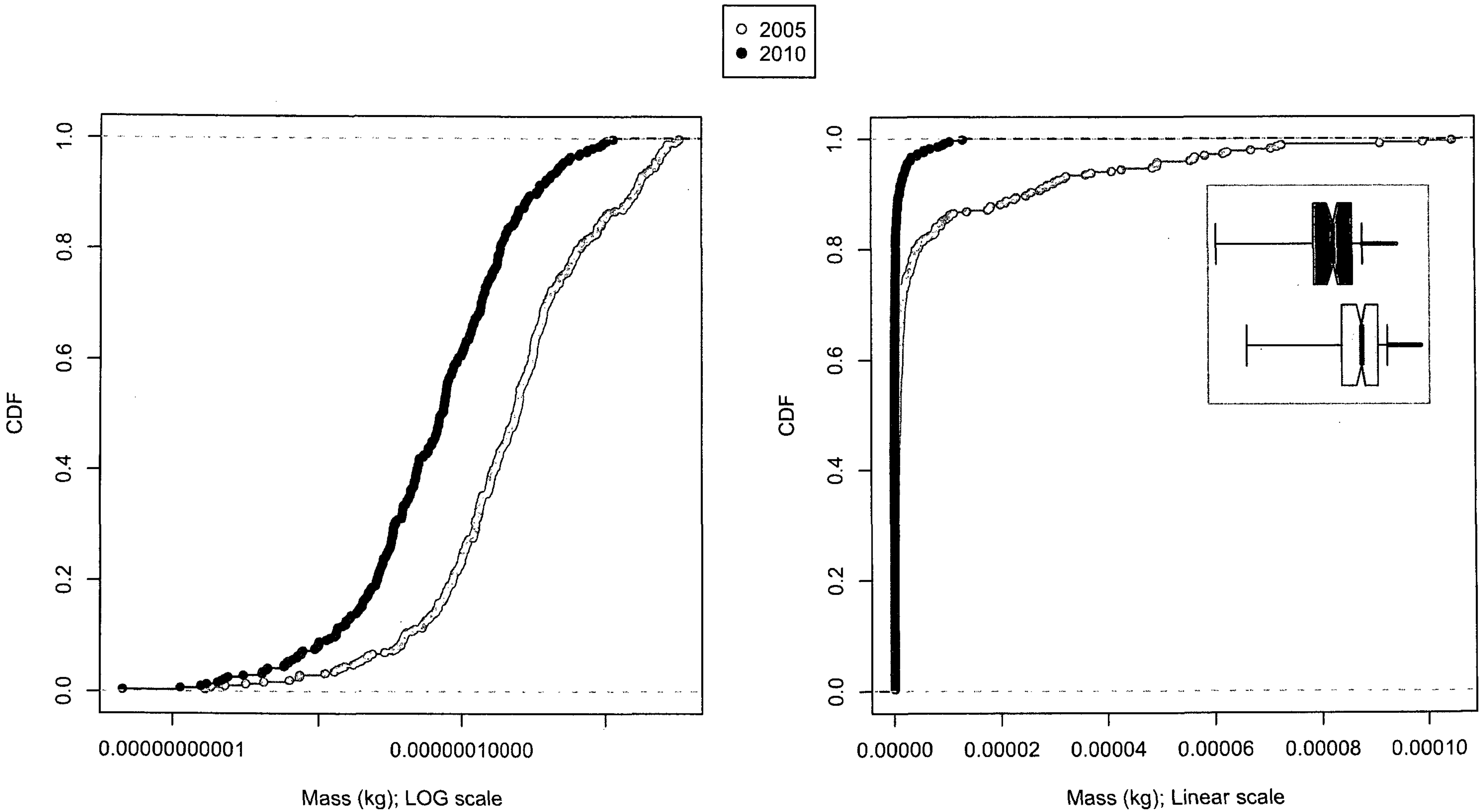

Figure B14
Comparison of 2,3,4,6,7,8-HxCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

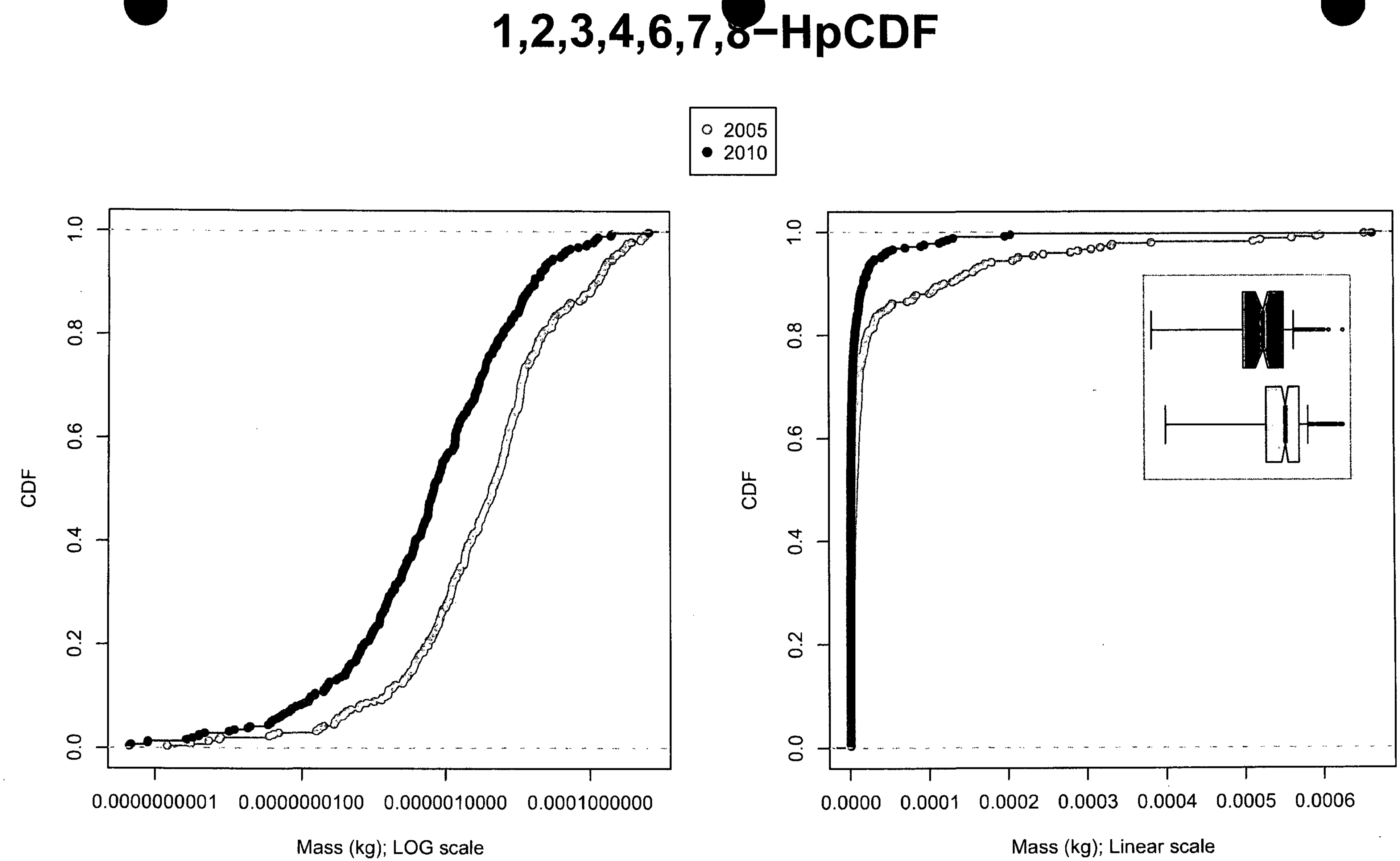

Figure B15
Comparison of 1,2,3,4,6,7,8−HpCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

1,2,3,4,7,8,9−HpCDF

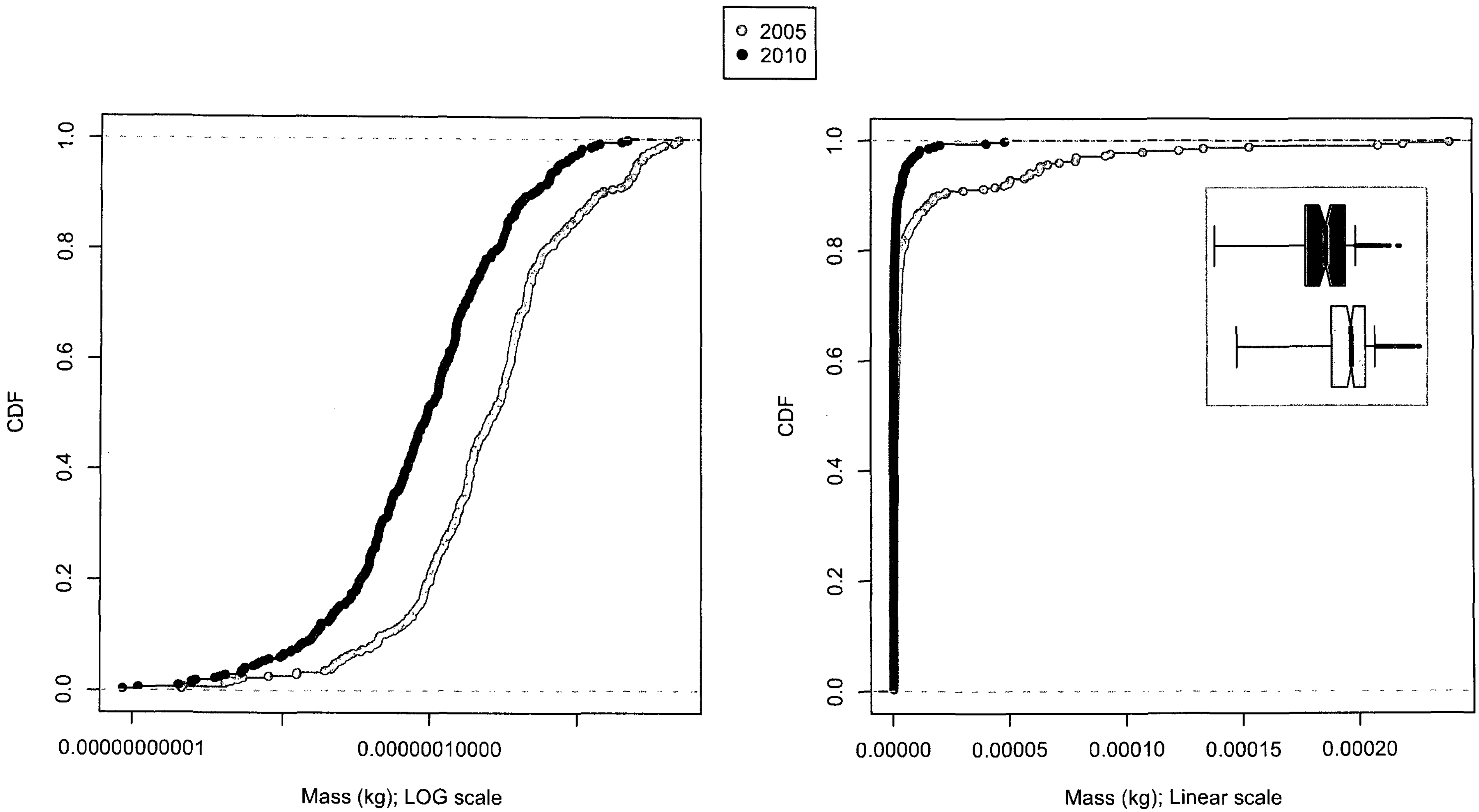

Figure B16
Comparison of 1,2,3,4,7,8,9−HpCDF mass in each Thiessen polygon corresponding to both a 2005 and a 2010 surface sediment sample

OCDF

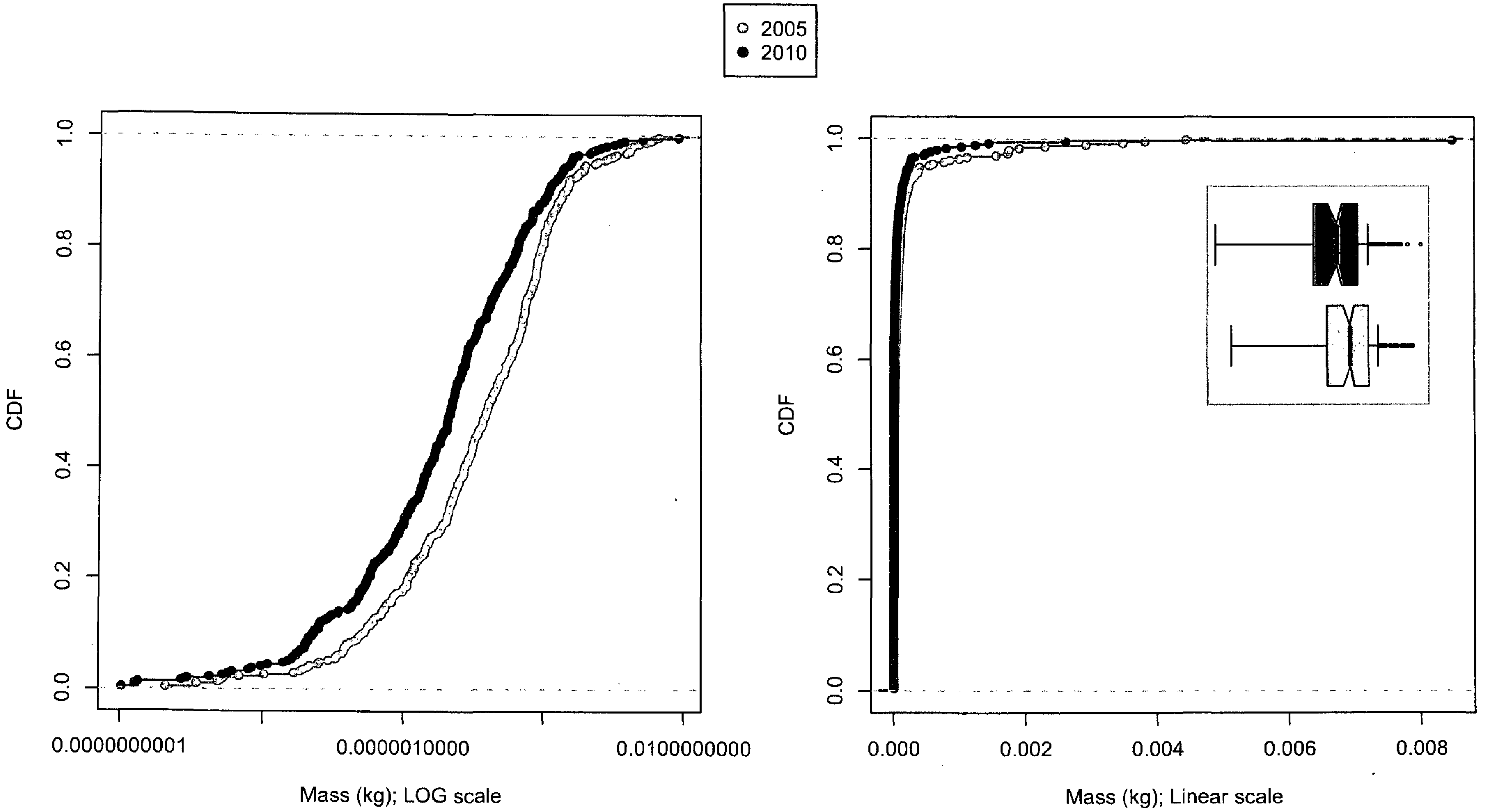

Figure B17
Comparison of OCDF mass in each Thiessen polygon
corresponding to both a 2005 and a 2010 surface sediment sample

Total D/F

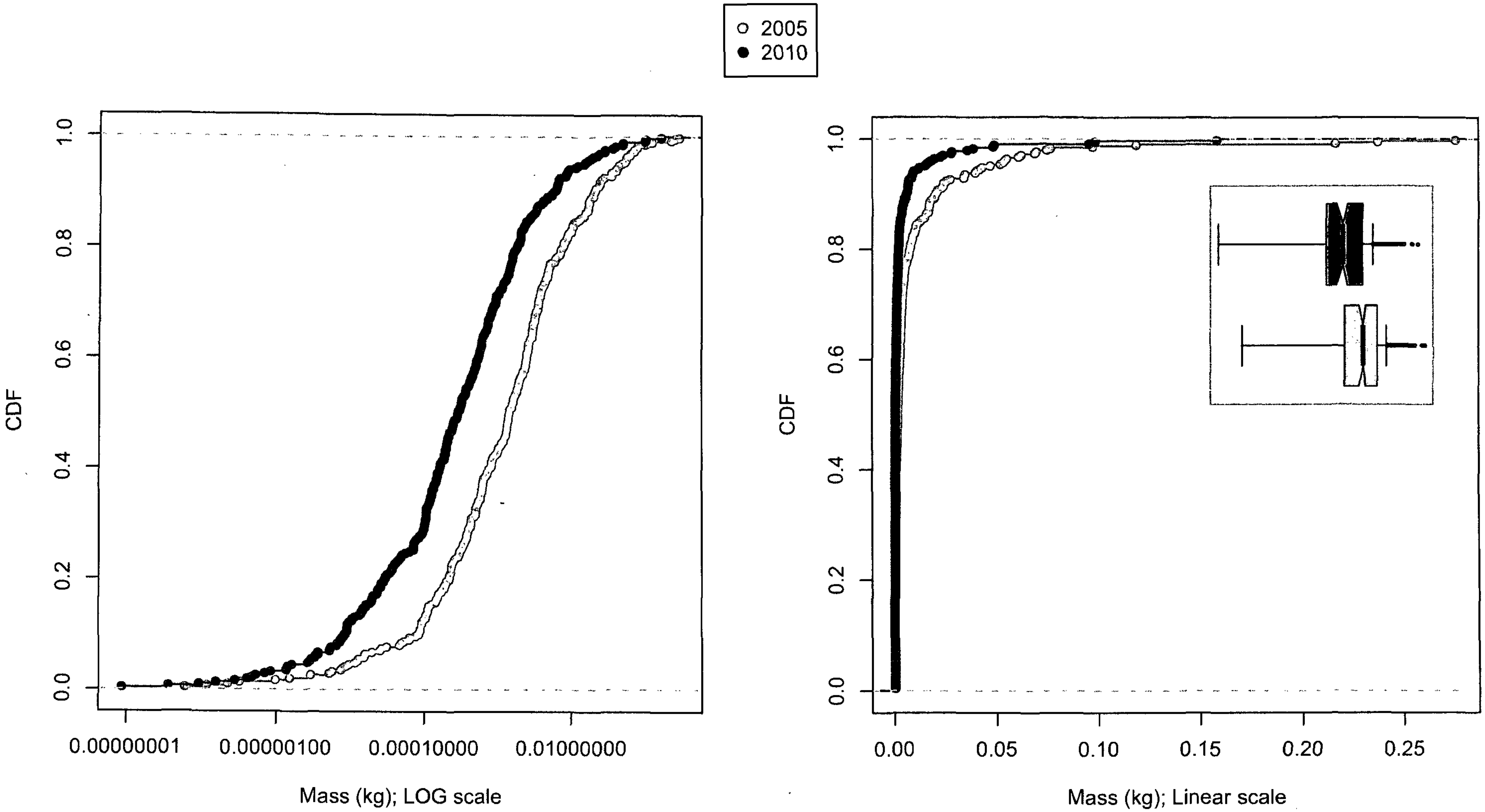

Figure B18
Comparison of Total D/F mass in each Thiessen polygon
corresponding to both a 2005 and a 2010 surface sediment sample